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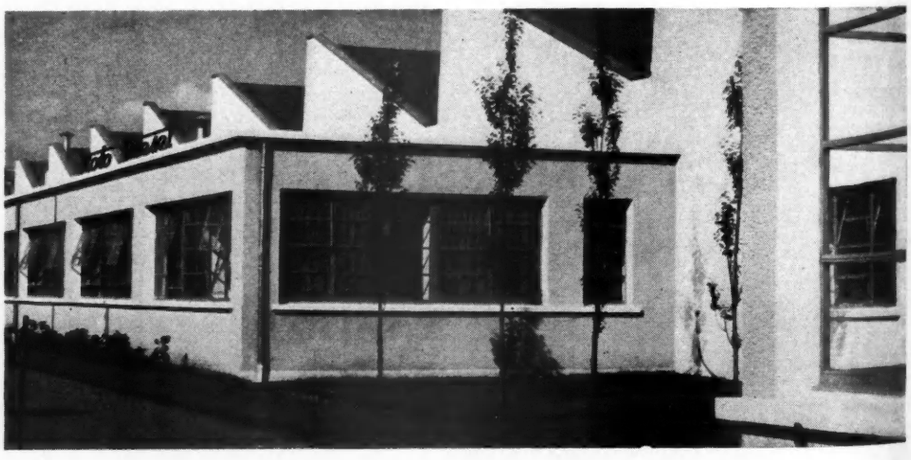

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Craftsman in steel: setting cores in a mould for a complicated steel casting required for coal cutting machinery. This is a typical example of the "tailor-made" product of the steel industry. (*Nurnberg photograph for* ENGINEERING)

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ENGINEERING Impact

of Boating being Big Business

THE traditional British love of the sea is finding a new outlet in the phenomenal increase in sailing and boating as a recreation. The outboard motor especially has been highly developed and widely applied, bringing in its wake extensive export sales that are rapidly increasing in value.

Use extends from the arctic to the tropics, and suitability to all crafts from small dinghies to large cabin cruisers. Small fishing boats so equipped reach grounds which would otherwise be inaccessible, houseboats are enabled to change their station, and pontoons take on a manoeuvrability previously denied them. In short, the outboard motor is flexible in application and operation, and of much value not only for pleasure—with which it is mainly associated in the public eye—but also for commercial use and the manifold purposes of the Services.

Power requirements range from a few horsepower up to 100, and if sufficient propulsion cannot be derived from one engine, two may be fitted side by side. Excellent power:weight ratios are offered and installation is normally very simple. Simplification is taken further when the engine is rotatable on its mountings, for reversing is then accomplished by merely turning the engine through 180°.

British-developed and built motors cater for world markets, including the North American continent. Technically they are highly developed, in service they are economical and, if required, able to operate for long periods without a stop, and the styling and finish are attractive. The demand has taken a big upward trend in recent years and there would appear to be no reason why this should not continue. While world demand (excluding America) for engines of from 6 to 40 hp has practically doubled in the last four years, the number of engines sold in the United Kingdom (including Northern Ireland) has increased 8·5 times. In the United Kingdom sales were 1,000 in 1958, rose to 7,000 in 1959, increased by 500 the following year, and are estimated to be 8,500 during 1961.

Such a rising interest in boating must soon force an increase in the facilities available.

Keeping Reservoir Water Clean

THERE is an ever increasing need for recreational facilities in Britain, in particular more and more people are interested in swimming, fishing and boating, especially boating. No one lives very far from the sea but on the other hand no one wants to waste time making the journey. In consequence considerable pressure is being exerted to open up reservoirs for these purposes. What are the problems involved, and why cannot the water companies earn some revenue from the facilities at their disposal?

First of all, the prime responsibility of any water authority is the preservation of the purity of the water they sell. Even if the water in the reservoir is abstracted from very impure rivers, it should not be overlooked that the passage of the water through the reservoir brings about a very considerable improvement in quality; in effect, this is the first stage in the purification process. Then again, many cities such as Liverpool, Manchester and Birmingham go great distances to impound pure water in remote mountain catchments. It would be at least illogical to risk defeating one of the objects of going so far afield to obtain clean water by permitting large scale use of the impoundment for recreational purposes and consequent pollution. Where water from such reservoirs is not filtered before distribution, it is obviously not in the interest of the owners to risk pollution by permitting large scale recreation. Where the water is in any case subsequently filtered, much of the advantage of gathering in "clean" areas and of long duration storage might be lost, and certainly the task, and cost, of filtering increased.

Swimming, therefore, must be rejected outright in those reservoirs used for water supply, though it might be allowed in those intended mainly to provide compensation for the rivers. Boating is generally prohibited, though there is less objection to sailing than to motor boats. Fishing is nearly everywhere encouraged and many of the water authorities are rightly proud of the trout fishing that they can offer.

Combining Teaching and Research

AT the annual Commemoration Day address at the Imperial College of Science and Technology, the visiting speaker was the Rt. Hon. the Viscount Hailsham. As the Minister for Science, one of his main problems is the amalgamation of teaching and research in science.

The universities, he said, are a "true melting-pot of society; the one great mixer where class distinctions are being abolished before our eyes . . . the one democracy where equality of opportunity is not confused with equality of achievement, reward or esteem." One of the tasks of the universities is to provide vocational training, and on this plane the standard of teaching required for scientists today cannot be separated from research. The universities are a natural source of research workers, and research will become barren and the quantity reduced if attempts are made to divorce it from places of learning.

In the United Kingdom the main patron of the universities is the State, and to administer the state's interest the University Grants Committee was set up in 1919. This committee has increased the total value of the grants threefold within the past four years.

The increasingly wide range and size of research tools has brought a heavy responsibility to the Government. Should new institutions be set up, as the National Institute for Research in Nuclear Science at Harwell; or, since some newly emerging fields of study are too large almost from the outset for a single national budget, should international organizations be developed?

It has been questioned whether the universities are too dependent on Government money—in America the reverse is the case, with very little interest being shown by the federal government. There, much of the money comes from industry, the advantage being that industry follows university activities closely and is graduate conscious. In this country, outside a few principal examples, this is not generally true. In Germany there is no such apartheid between the two sides, to the extent that certain industrial concerns operate their own research institutes within the technical institutes.

of Supersonic Indecision

MANY conflicting views have been expressed as to when supersonic transport aircraft will be introduced. On the one hand, it has been said that a British aircraft could be flying by 1966 if the Government accept the proposals in the British Aircraft Corporation's design study; and on the other, there is a recent prediction at the International Air Transport Association's meeting in Sydney, made by Dr. Keith Glennan, that supersonic transports would not be operating until after 1970. How does the aircraft industry or any other industry adjust itself to the fluctuating forecasts about the products it hopes to and is expected to build?

The simple answer is that it must have no reaction. Apart from the psychological setbacks which must inevitably attack the people involved in a project, design studies must continue regardless. Various defence projects—dare Blue Streak be mentioned?—have been and will in the future be the subject of continual controversy several times a year. Design study teams have an allotted task and with given parameters they must produce results. While preliminary investigations are still under way, a project is flexible.

In the face of fluctuating technical, and, in any large project, political opinions, industry must remain insulated from but not aloof to change in policy and ideas. Its purposes must remain firm but not inflexible. If industry reacted any differently it would find itself the victim of the ulcer it so frequently gives to its servants.

Analysing Shipbuilding Abroad

THE firm of accountants appointed by the Minister of Transport to find out why shipbuilding orders go overseas, have now reported back. Their report, *Shipbuilding Orders Placed Abroad by British Shipowners* HM Stationery Office (1*s*), is based on a sample of 34 ships, representing a total tonnage of 198,825 tons, which, since early 1959, have been built in foreign shipyards instead of in this country.

The stories of the 34 that got away make instructive reading. Seven of them went overseas without British yards having an opportunity to compete because the foreign yards had already satisfied the shipping lines concerned in meeting earlier orders. Of the remainder, the lowest British tender was from 4 per cent to 30 per cent higher than the tender price accepted. There were even cases of UK yards quoting on a "cost plus" basis instead of on a fixed price.

There was no significant difference between the delivery dates offered by UK and foreign yards, but the latter gave the impression that they meant business by being prepared to agree to penalties for late delivery. Surprisingly, credit facilities (about which UK yards have tended to make a song and dance) available through some foreign yards were found not of primary importance in winning the contracts (though this point has been flatly contradicted by spokesmen for the British industry since the publication of the report).

Now that Peat, Marwick, Mitchell and Company have confirmed the worst fears about the industry, it is to be hoped that both unions and management will be more inclined to face the fact that there is nothing wrong with the industry that an intelligent and 20th century human relations policy, plus modernization of equipment, cannot cure—provided, of course, they are administered in time. As far as the unions are concerned, this must mean a serious movement towards a single shipbuilding union. As far as the employers are concerned, it means extensive plant modernization (many of them, of course, now see this) and the realization that no man gives of his best when he can be fired at a day's notice.

and Do-It-Yourself Information Work

AT what stage can a firm profitably start its own library and information service? An engineering firm which is expanding is bound to run into this question at some stage. Should a library and information department be established, or should the people who want the information be responsible for gathering it themselves?

A recent survey of a number of European firms produced some surprising results. In one German firm, for example, it was found that among the directors, over 60 man-hours a week were being spent in handling information.

Of course a large part of the time of directors and managers must be spent in absorbing information, otherwise they would be ill-equipped to reach sound decisions. But much of the labour of gathering information can more efficiently be done by an office charged with this responsibility. The directors and managers can then devote their limited reading time to more effective reading, as recommended by Mr. C. W. Hanson (ENGNG., vol. 190, 1960, p. 378).

The European survey was carried out by a team organized by the European Productivity Agency. A member of this team, Mr. Wilfred Ashworth, who is librarian and information officer of British Nylon Spinners Limited, talked about the findings of the survey to an Aslib meeting last week. A full report has been published by the EPA (ref. EPA/D/9491).

The value of information services to engineering firms was also stressed by an eminent engineer last week. In his presidential address to the Institution of Mechanical Engineers, Sir Kenneth Hague, chairman of Babcock and Wilcox Limited, suggested that the engineering industries could derive more benefit from a greater use of information services—as epitomized by Aslib—and could thereby avoid costly mistakes.

Propeller Meter with a Gas Bearing

A propeller flow meter has been developed for the measurements of gas flows with solid suspension. It can also be used for measuring all gas flows and pneumatically transported powders.

By J. W. Powell, B.Sc. (Eng.)
University of Southampton

THE heat transfer and flow characteristics of gas-solid suspensions are at present under investigation for the possible future development of gas-cooled nuclear reactor systems. It is expected that the increased coolant density and heat capacity will result in improved heat transfer from the reactor core to the boilers. In addition, it is hoped that the cost of the pressure vessel containing the reactor core will be reduced, as it is expected that efficient working pressures will be below those of the present generation of gas cooled power reactors.

When investigations began into the flow properties of gas-solid suspensions several difficulties were anticipated in connection with the measurement of velocity. The solid particles of finely divided aluminium oxide or graphite became deposited in stagnant regions and regions of reduced gas velocity. Thus, it appeared likely that flow measuring instruments, such as the venturi meter and pitot meter would become blocked by deposition of solid particles at their pressure connection entries. Previous investigations had found that existing propeller meters, of the type used for liquid flow, were prone to bearing failure due to the intrusion of solid particles. It was, therefore, decided that a requirement existed for a propeller meter with low bearing friction and a means of preventing the solid particles from entering between the bearing surfaces. This requirement was fulfilled by mounting the propeller on a pressure fed gas journal bearing.

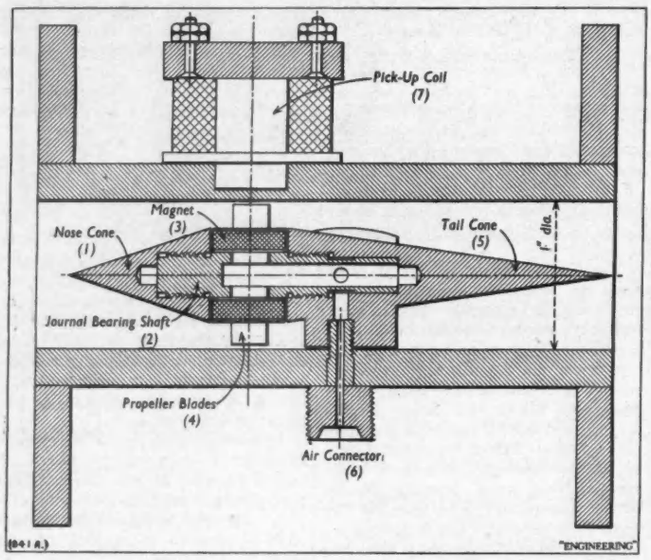


Fig. 1 (left) Sectioned view of the flowmeter in its fourth stage of development.

Fig. 2 (right) The signals induced in the pick-up coil by the rotating magnet are counted electronically over any pre-set time by a Dekatron valve counting device.

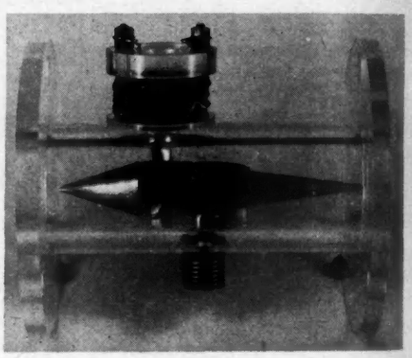
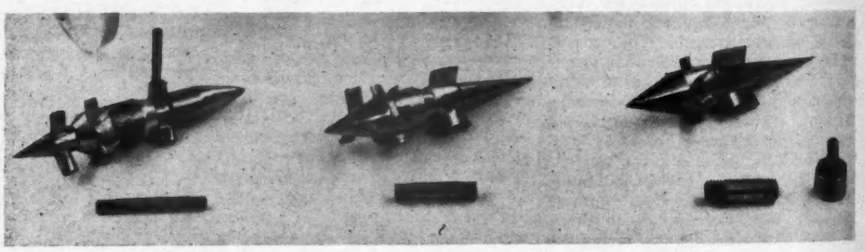


Fig. 3 (below) Three stages of development in the journal bearing. The rotor length was progressively reduced which produced a more efficient bearing of lower length-to-diameter ratio.



Design and Development

The flowmeter consists of a propeller carrying a magnet, mounted on a pressure fed gas journal bearing and gas thrust bearings, and arranged to rotate in the measured gas flow in close proximity to a pick-up coil (Fig. 1 and 2). The signals induced in the pick-up coil by the rotating magnet are counted electronically over any pre-set time by a Dekatron valve counting device.

The four development models of the flowmeter were designed to measure flow in a 1 in diameter tube over a range of gas velocity from 0 to 100 ft per sec. The small size of the instrument necessitated the development of a small pressure fed journal bearing of sufficient strength to withstand the dynamic loads imposed upon it by the propeller and magnet rotating at speeds of up to 20,000 rpm. The wide speed range was decided upon in order to produce good sensitivity and discrimination. A journal bearing of $\frac{3}{16}$ in diameter was used on the initial model but redesign of the rotor enabled the bearing diameter to be increased to $\frac{1}{4}$ in and finally $\frac{5}{16}$ in with considerable increase in bearing strength but without reducing the size of the magnet or increasing the outer diameter of the rotor. From Fig. 3 it can be seen that the length of rotor was progressively reduced, which both lessened dynamic loads and produced a more efficient bearing of lower length-diameter ratio. On the early models air was fed to the thrust surfaces through feed holes, but because of vibration trouble the thrust feed holes were blocked and it was found that the thrust bearings operated well on the exhaust air from the journal bearing. This discovery was fortuitous since it greatly simplified the design and construction of the flowmeter.

A sectioned view of the fourth development flowmeter is shown in Fig. 1. The nose cone (1) is screwed onto the journal bearing shaft and its rear face forms one surface of the front thrust bearing. The journal bearing shaft (2) screws into both nose and tail cones. It is hollow for most of its length so that air from a high pressure source is led to the journal bearing feed holes on the shaft. The rotor consists of the magnet (3) and the propeller (4). The ground hole in the centre of the magnet forms the journal bearing surface and the ground flat ends of the magnet form the front and rear thrust faces. The six propeller blades are mounted on a thin sheath shrunk onto the outer magnet surface; the blades are set at 20° to the direction of the gas flow and are shaped with a symmetrical aerofoil section. The tail cone (5) is located centrally in the 1 in diameter tube by three locating vanes into one of which screws the air connector (6), and through which the air from a high pressure source is led to the bearing shaft. The flowmeter housing consists of a 1 in internal diameter tube with flanges at either end and on the outside of which, opposite to the magnet, is mounted the pick-up coil (7).

The development flowmeters were made mainly from brass and with a perspex housing, but the design is such that all components, excepting the magnet and the coil, can be made from stainless steel. Thus the flowmeter will be capable of operating at temperatures up to 300° C.

Operation and Performance

The flowmeter connects into and forms part of the measurement circuit. Compressed air is fed to it through a filter and pressure reducing valve and normal operating pressures are in the range 20 to 50 lb per sq. in. The terminals of the pick-up coil are connected to the Dekatron valve counting device which, in addition to counting propeller revolutions over a pre-set period, gives a continuous reading of rotor speed by means of an ammeter which reads the integrated current of the counting valves.

It was seen in the tests on the early flowmeters that the voltage induced in the pick-up coil was directly proportional to the rotor speed over the whole of the speed range, and this fact offers a simpler and considerably cheaper method of speed measurement than the Dekatron, though the latter is capable of very high accuracy.

Tests were carried out on the development flowmeters in which they were calibrated in clean air against a venturi meter and a pitot meter. A typical set of results is shown in

Fig. 4. The interesting fact which emerged was that there was no detectable slip of the propeller blades relative to the measured air flow. The effective pitch of the blading appeared to coincide with the geometric pitch at the mean chord position. This was undoubtedly due to the very low friction of the pressure fed air journal bearing. It is thus suggested that flowmeters of this type do not need calibration and that they can be adapted to cover any speed range by adjustment of the propeller blade angle.

Three models of the flowmeter have been run for periods of several hours in solid suspensions of up to 20 lb of solid per lb of gas. No bearing failures were attributed to solid particles penetrating between the bearing surfaces and stripping after tests showed no solid particles penetrating into the journal bearing clearance space.

Advantages

The advantages of the propeller meter with a pressure fed gas journal bearing may be summarized as follows:—

(a) The flowmeter may be used to measure gas flow and the flow of gas with solid suspension.
(b) The low bearing resistance permits the propeller performance to be determined accurately by the blade geometry.
(c) The low bearing resistance and low rotor mass provide a quick response to changes in flow.
(d) The two identical thrust bearings enable the flowmeter to be used in any attitude.

Possible Applications

The meter may find applications wherever continuous, accurate, and direct-reading measurements of gas flow are required. The gas bearing will operate with any gas and most vapours as the lubricant, and so the flowmeter may be used to measure most gases and vapours without them becoming contaminated by the bearing gas. Applications are therefore suggested in chemical plant where, by suitable choice of materials for the flowmeter components, most corrosive gases and vapours could be dealt with over a wide range of temperatures.

The low temperature limit is governed only by excessive condensation of vapour within the bearing and the high temperature limit is set by the demagnetization of the magnet steel. Finally the ability of the flowmeter bearing to exclude solid particles suggests applications to the measurement of gas flows contaminated with dust and to the measurement of flow of pneumatically transported powders.

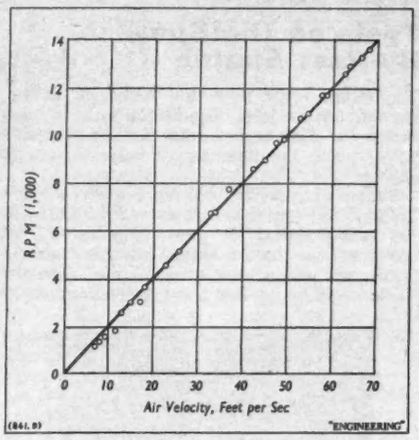


Fig. 4 Calibration of the fourth development flowmeter against venturi and pitot meters. The experimental points and the line of no propeller blade slip are shown.

Acknowledgements

This work was carried out in connection with an investigation into the properties of solids in gas suspension which was sponsored by the UKAEA, Winfrith, and implemented in the Mechanical Engineering Department of Southampton University. Provisional patent specifications were filed on 21 March '61.

Checking Aircraft Electronic Systems Automatically

Although it may sound naïve, the purpose of an aircraft is to fly. The point of this simple statement becomes apparent when it is remembered that the more time a military aircraft spends on the ground the less able is it to perform the task for which it was built and with civil aircraft the less revenue they are able to earn.

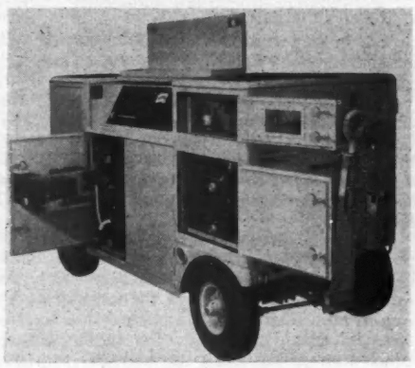
The RAF have ordered a number of Honeywell systems analysers for use with their English Electric Lightning fighters. With such aircraft, speed is vital in locating faults in wiring and subassemblies of electronic systems. The analyser is an intricate mechanism for simplifying the tests on these systems and is used to ensure that an aircraft's electronic controls are operating.

To check an aircraft manually would take several days, but the analyser can check out at the average of one test per second in a matter of hours and is said in fact to be about eight to ten times fas er than doing it manually.

The analyser performs its tests by using information punched out on plastic tape. Whichever circuit is to be tested, the appropriate test tape is placed in the tape reader which allows it to control the test circuit. Various operational manoeuvres are simulated and the system indicates whether the circuit is working correctly. The object of each test is to isolate whatever fault may be found by tracing it down to a system black box or a replaceable unit. Signals from the system being checked are compared with predetermined standards of acceptability. The trouble is diagnosed and indicated by code to the operator. It is then possible to go straight to the offending member and replace or remedy it. To ensure that the analysers tests are valid it also tests itself for possible errors and this takes about 15 to 20 minutes.

In the USA, Honeywell systems analysers have been in use for more than two years where they have been employed on automatic maintenance of the F-101 aircraft. The units will be made at Honeywell's Hemel Hempstead plant.

Honeywell Controls Limited, Greenford, Middx.



The RAF's Lightning fighters will have their complex electronic systems automatically tested by this systems analyser in a few hours.

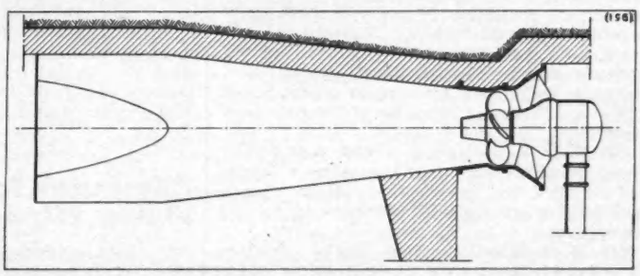
Bulb Turbines Give Cheap Power from Low Heads

The North of Scotland Hydro-Electric Board have recently placed an order for the supply and erection of two bulb-type water turbo-generators for the Awe Barrage in Argyllshire. These units are said to be the first bulb-type turbines to be installed in the United Kingdom.

In view of the fact that the height of the civil engineering works had to be kept low to avoid spoiling local amenities, and to avoid costly excavation work, bulb-turbines were chosen. These submerged axial-flow units are largely the outcome of research aimed at reducing the manufacturing and civil engineering costs of plants operating under very low heads. Several are in use in France. The net operating head at the Awe Barrage is 22½ ft and the turbines will each develop 695 bhp (about 520 kW).

The units are submerged with oil-surrounded alternator rotors. This type can only be used for outputs of up to 4,000 kW; over this size, air-cooled synchronous alternators are used. Although 1 per cent more of the output is lost by friction when running in oil than in air, the attractive thing about this type of layout is that there are no cooling problems to deal with, the reason being that oil is ten times as conductive as air and has a much higher specific heat.

Bulb-turbines have been chosen for the Awe Barrage scheme in the north of Scotland. They are particularly suitable for operating on low heads. The units are submerged and have oil-surrounded alternators.



Whatever the application of these units they always include the following three basic components: (a) a runner, (b) a fixed guide vane assembly, and (c) an asynchronous alternator upstream of the runner and guide vane. The oil used for cooling the alternator is stored in the bulb and kept at a higher pressure than the water surrounding the unit by a header tank set above the upstream water level. This is done as a safeguard against the disastrous effects that would result if the water found its way into the oil in the bulb.

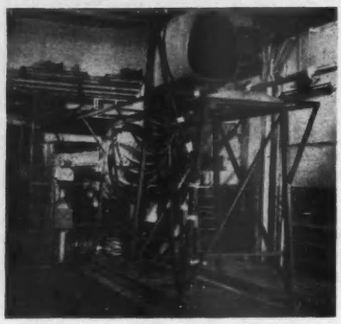
The turbines are manufactured by Ets Neyrpic of Grenoble and the driving induction generators by Alsthom of Belfort. The equipment will be supplied by the Armfield Hydraulic Engineering Company, who have also been awarded the contract for the turbine inlet and outlet gates.

The Armfield Hyrdaulic Engineering Company Limited, Ringwood, Hants.

Tests on the Spey By-Pass Engine

The recent order from the American airline, Braniff, for six BAC One-Eleven airliners also means the first export order for the aircraft's power plant, the Rolls-Royce Spey by-pass jet engine.

This engine, which will also power the dH Trident, has a take-off thrust of 10,000 lb and has been designed for outstanding operational economy—low fuel consumption, low maintenance costs and a long overhaul life. The dH Trident will be the first Spey engined aircraft to



The Spey engine under test is mounted behind the long S shaped air intake which leads to the centre engine of the three-engined Trident installation.

fly and in August of this year initial taxying and ground running trials with the engine installed in the aircraft were completed.

Meanwhile another important stage in the development of the Spey was reached in early October, when flight trials began with two of the engines installed in the inboard nacelles of an Avro Vulcan test bed aircraft. These trials came less than ten months after the engine had first run.

During the development of the engine more than 1,300 hours of experimental running have been accumulated, and a preliminary 150 hours run has been completed to the combined Air Registration Board and Federal Aviation Agency type-test schedule. In addition to the normal bench testing, this work has included extensive endurance running in a fully equipped production standard Trident pod. Here the relevant power and air offtakes for ancillary purposes have been applied and checks made on the functioning of the thrust reverser and silencer.

In the short and medium range transport aircraft for which the Spey is specified, engine reliability and overhaul life is influenced by the frequent use of take-off power. Using the experience of millions of hours of short sector operations gained with the Rolls-Royce Dart and Avon, new forms of cyclic overload test procedures have been evolved. In this way valuable background information on the Spey's "hot end" life and reliability is being accumulated.

Tests in Rolls-Royce's altitude test facility have included checks on re-lighting over a range of altitudes, and investigations of the engine's windmilling and flight idling rpm under varying conditions.

Rolls-Royce Limited, Aero Engine Division, PO Box 31, Derby.

1000 MW Turbo-Generator Set for USA

A steam turbine generator unit, said to be the world's largest and capable of generating in excess of 1,000 MW, has been ordered from Allis-Chalmers Manufacturing Company of New York by Consolidated Edison Company. It will form part of a $131,000,000 generating facility adjacent to the East River station.

In announcing the order, the chairman of Consolidated Edison said that technical development had made machines of such a size feasible for utility systems large enough to absorb the great blocks of power the machines represent.

The turbine generator will be of two-shaft design. The turbine will have five stages; one high pressure, one intermediate and three low. The high and intermediate sections will be coupled in tandem to drive one of the two fully supercharged, hydrogen cooled generators at 3,600 rpm. The three low pressure sections will be coupled in tandem to drive the other generator at 1,800 rpm.

Steam conditions at the turbine stop valve will be 2,400 lb per sq. in and 1,000° F. After passing through the hp section, the steam will return to the boiler for reheat to 1,000° F before entering the intermediate turbine section.

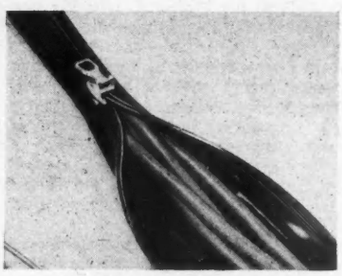
The new unit, scheduled for operation in 1966, is the third large steam turbine-generator ordered from Allis-Chalmers by Consolidated Edison since 1957. The first, with a capacity of 410 MW, was put into service in March of this year. Early in 1962 a twin machine will be placed in operation at the same station.

Allis-Chalmers Manufacturing Company, 551 Fifth Avenue, New York 17, USA.

Cable Covers Can Be Zipped Up

A plastic cable-cover with interlocking beading along each edge is available from Hellermann Limited. When wrapped around lengths of cables the cover will interlock by zipping the two sides together.

The cover is claimed to be dust and moisture proof, extremely tough, lightweight and suitable



Plastic covers for protecting electric cables can be zipped together.

for varying atmospheric conditions. It can be used in place of conduit or in certain circumstances as a cover for conduit that will prevent corrosion.

Known as "Helazipp", the covers enable wires to be easily traced and without having to undo work previously carried out. Available in black or transparent, Helazipp is made in sizes (i/d) varying from $\frac{3}{8}$ in. to 3 in. and wall thicknesses from 0·015 to 0·020 in.

Hellermann Limited, Gatwick Road, Crawley, Sussex.

Computer for Flying Wind Tunnel

An airborne analogue computing system to provide instant reduction and readout of test information aboard a flying wind tunnel and laboratory has been delivered to a US Naval air station by the parent company of Electronic Associates Limited.

The flying wind tunnel is an undertaking of the Subsonic Aerodynamics Laboratory of Princetown University working in cooperation with the Research and Development department of the Naval Air Station at Lakehurst, New Jersey. In conducting tests on VTOL and STOL aircraft, a powered or unpowered model is flown beneath an airship at the end of a hollow tube which can be extended 20 ft. The model is directly attached to a three-component strain gauge balance designed to measure the model's lift, drag and pitching moments.

The reason given for using an airship for a flying wind tunnel is because the air beneath it is very stable and free of turbulance. Another advantage is that the models can be tested in free air and at low speeds, which eliminates many of the aerodynamic problems encountered in conventional wind tunnels.

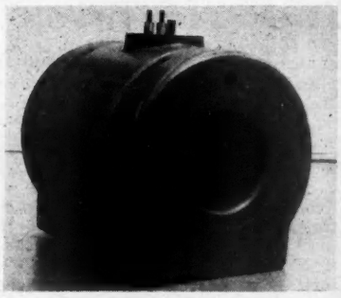
The computer system, based on three transistorized TR-10 desk-top general purpose analogue computers, is housed in the laboratory in the cab of the airship where information from the model is reduced and presented. The data can either be graphically presented on a plotting board or converted to digital form and printed out. Continuous processing of information during flight tests eliminates the need to record the data and then have to process it in a ground laboratory.

Electronic associates say that the US Navy chose the TR-10 computers because their solid state design makes them compact and they are said to perform many of the data handling tasks of larger units. The company also say that this is the first time that laboratory-type computers have been used in an airborne application. A fourth TR-10 will be installed in a trailer laboratory. Other equipment by Electronic Associates includes a scanner, transistorized digital voltmeter for analogue-to-digital conversions, two plotting boards and a digital printer, *Electronic Associates Limited, Victoria Road, Burgess Hill, Sussex.*

Encapsulated Transformers

Fully encapsulated current transformers are to be used on the Eastern Region of British Railways for the high speed multiple unit electric trains which will operate between Liverpool Street and Clacton.

Because the transformers are fully encapsulated, they will be mounted on the under frame of the motor coach without additional protection against stones, weather and moisture. The transformers themselves are made by GEC Limited and Permali Limited carry out the encapsulation with epoxy resin. Permali also



Encapsulated transformers for fitting on the underframe of electric trains.

produce the moulds and the moulding holes are finally plugged under vacuum to ensure complete protection.

The transformers after encapsulation measure 12¼ in long by 10¼ in deep by 10¼ in diameter.

Permali Limited, Bristol Road, Gloucester.

A burner which consumes waste and residual fuels and is manufactured by Thermic Equipment and Engineering Company was described recently (ENGNG., 22 Sept. '61, p. 367). From information since received we understand that the air heaters, designed to complement the burners, incorporate no refractory lining.

A Chassis and Body to Go with an Engine

The growing interest in converting production cars to give higher performance has led to a wide range of replacement parts for this purpose. Several firms offer complete car bodies for the conversion of a family saloon car into a sports car. Equipment for raising the engine performance to match is available too. Taking this trend to its logical conclusion, some manufacturers offer kits of parts for complete cars. Enthusiasts can choose from several chassis types, engines, and bodies and build up a car to suit their requirements. A new car, moreover, on which they do not have to pay purchase tax.

The LMB chassis is an example of the type available to the amateur builder. It is produced by LMB Components Limited, Guildford. Two models can be had: type A for Ford E93A or 100E engines, and type B for Ford 100E, 204E, and 105E, or BMC series A or B engines. The main differences are in the rear axle and its method of location, and in the front axle fittings. The company claim that the chassis is suitable for racing, sports, or saloon cars.

The chassis frame is of a simple ladder construction. It comprises two 16 swg deep rectangular side members of hollow section, with large diameter tubular cross members. For a bare weight of 85 lb a very high beam and torsional stiffness is achieved. The track is 48 in and the wheelbase is 7 ft 6 in. And it will accept any standard glass fibre body intended for this wheelbase.

The semi-swing axle front suspension uses two suspension arms pivoted at an angle to the fore-and-aft plane of the chassis. This reduces the amount of camber change due to wheel deflection when the vehicle is driven in a straight line, but leads to a progressive increase in the negative camber of the outer wheel when cornering. Universally jointed shackles connect the ends of the arms to the double cantilever transverse spring. The lower ends of the shackles form attachments for the transversely mounted Armstrong piston-type shock absorbers. Forward-mounted divided track rods provide the correct degree of Ackerman action.

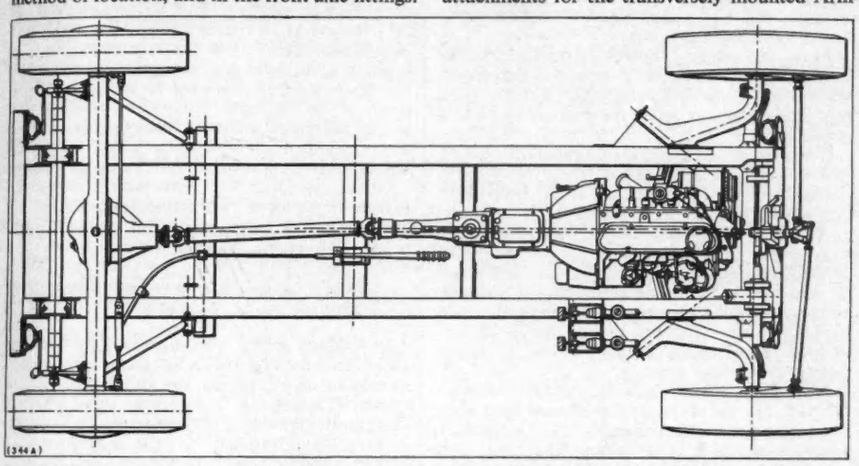
The rear suspension consists of a double cantilever transverse spring with piston-type shock absorbers. Axle location is provided by an A bracket on the type A chassis and by four radius rods with special shackles on the type B chassis.

An example of the type of car that can be built up on the chassis is provided by the LMB Debonair. This is produced from the Ballamy Debonair Car Kit, which came on to the market during August. The kit consists of the Debonair body manufactured by E.B. (Staffs) Limited and the LMB B-type chassis. Using a Ford Anglia engine, the complete car can be built for approximately £750.

The body is moulded in glass-fibre reinforced polyester resin. At stressed points, up to nine layers of mat are used to give the necessary strength and rigidity. The external bodywork is cellulosed to normal production car standards. In the G.T. saloon body there is comfortable seating room for two, with space available for two more.

The full flooring of the interior of the saloon and boot are constructed in resin bonded marine ply, forming a complete interior shell, mating up with the glass fibre wheel boxes and front bulkhead. Removable glass fibre propeller-shaft tunnel, and spring anchorage and differential inspection covers complete the straight-through flat flooring.

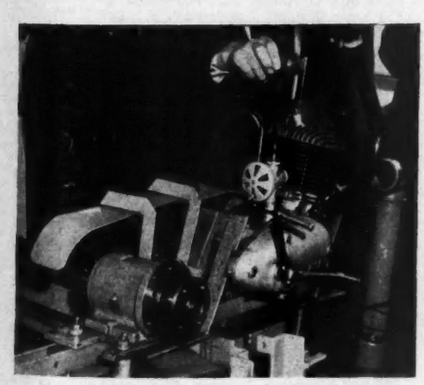
The interior front bulkhead extends rearwards to the door edges, and the rear bulkhead forms the rear seat back-rest, dividing the passenger compartment from the boot. Behind the rear seat is a parcel shelf. Particular attention has been paid to weather sealing: each door has a double rebate, the inner one carrying a rubber seal. The engine compartment is accessible through a double skin forward-hinged bonnet lid, locked from the inside of the car. The compartment contains the wheel arches and ducting from the aluminium grill to the radiator. Overall length of the body is 13 ft 4 in and overall width, 4 ft 10 in.



The LMB chassis is of simple ladder type construction. Suspension is by double cantilever leaf springs with trailing radius arms at the rear and a semi-swing axle located by a leading link system at the front.

Good Start for Two Strokes with New Ignition

Two-stroke owners can now choose an alternative to magneto ignition, without having to buy a battery. Wipac Group Sales Limited offer a condenser-discharge system that appears to be the answer to the two-stroke owner's prayer. It is said to make starting a lot easier. In fact, it allows the use of fuel/oil ratios that were previously considered non-combustible. In one test a 4 : 1 petrol-oil ratio was used in a 24 : 1 engine. While maximum power is not claimed for such a ratio, starting and running at low speeds were not affected. An erratic ratio produced while the machine is parked is the chief cause of difficult starting in two-stroke engines.



The Wipac condenser discharge ignition system continues to fire the engine under such conditions of abuse as a waterlogged sparking plug.

The condenser-discharge system, called the Magister, varies from the conventional magneto in that the high-tension ignition coil is replaced by a feed coil. As in the conventional system, this generates an alternating current but the current is passed through a small rectifier, to give a direct current charge to a condenser. The charge builds up in the condenser until the contact breaker closes. When it does so a heavy current passes through a stationary ignition-coil primary. The high voltage induced in the secondary is taken to the sparking plug.

Producing the spark during the closing of the contact breaker gives distinct advantages. In conventional magnetos the spark is produced at the time of opening; and the arc formed by the current is extended over a period of time. By closing the contacts to produce the spark, the discharge rate is higher. This reduces arcing and increases the life of the points. Wipac say that the system is also much less sensitive to oil and dirt on the contact points. Tests by subjecting an engine to conditions of extreme misuse, including pouring water over the sparking plug, and inducing oil at the air intake have been successful. The engine started and continued firing despite all the efforts to the contrary.

With a conventional magneto, the contact-point break must be accurately timed in relation to the magnetic break. With the discharge system, however, the timing is not so critical. This is because the condenser holds its charge until the contact breaker closes. And although a recommended contact clearance is given, variations from this do not affect the magneto output.

Experiments show that use of the Magister unit makes it necessary to retard the ignition by from 3° to 4°. Wipac conclude that firing of the mixture in the combustion chamber takes place at a higher flame rate than in conventional systems. The retarding effect still provides optimum output from the engine.

Although the condenser discharge principle is not new, previous systems have been too expensive to warrant mass production. The Wipac system, however, is said to be economically practical, with the added advantage of not requiring expensive surface-discharge types of plugs. It could have far-reaching effects on the two-stroke engine, making it a much more reliable source of power. In particular, the system would make the two-stroke more suitable for marine and agricultural use.

While the advantages of the system are not so pronounced for four-stroke engines, it makes it possible to use varying grades of fuel on a standard four-stroke engine with no special adjustment to the carburettor or to the timing.

Plain Words

By Capricorn

OUR concepts of war range so widely today that it is impossible to know whether traditional weapons like field guns will ever again be used on a large scale, or whether they are already weapons of the past. Top scientists and engineers talk quite seriously of a war being fought in outer space, but at the other end of the scale I suppose there are still many soldiers, enthusiasts in their profession, who can see a place for traditional armaments in the future. I cannot help feeling that we have seen the last of the field gun, except for local skirmishes. It makes me sad to think that perhaps the long line has come to an end.

How low can you get?—to think that a man can go all misty-eyed about such weapons of destruction. But I confess I do. Those pieces of ordnance were beautiful things. There were, of course, the little pip-squeaks such as the British 2 pounder during the Second World War that made men curse the generals, the Government, and everyone in authority for putting such suicidal machines into their hands. Whether it was mounted in a tank or set up as an anti-tank gun (don't laugh), it looked more likely to produce out of its muzzle a cork on the end of a piece of string than an armour-piercing shell.

But what about the great guns, the noble pieces? I am not competent to put them in order of esteem, but in engineering terms the French 75 mm took a lot of beating. It was a marvellous machine of hydraulic and pneumatic ingenuity, and it was produced in large numbers at a time when the very fine limits and fits it required were unfamiliar to most engineers. Switching back to the British Army, I think of the 25 pdr—what one might call the base-load weapon of the Second World War. Not very big nor devastatingly lethal, but versatile, mobile and superbly handled by the artillerymen. Dug down for a big barrage, or stopped suddenly on the move and brought into action to fire point blank at enemy tanks, it was the mainstay of the gunners.

And there was that box of conjuring tricks, the 18 pdr mountain gun, which was carried in pieces on the backs of mules, particularly on the North West Frontier. For all I know it may still be standard equipment for some mountain regiments, because there can hardly be another gun which is so readily dismantled or assembled.

On a note of respect—not to say fear—I mention the German 88 mm. As field gun, tank gun or anti-aircraft gun, it inspired an inferiority complex in anyone at whom it was pointed. If they are all confined to military museums, I'll be happy.

And on a note of admiration, I'll end with the hope that the Royal Horse Artillery will never give up their right to gallop into Hyde Park, their guns and limbers bouncing, their harness jingling, and their plumes waving triumphantly, to fire a royal salute with their gleaming guns.

Letters to the Editor

"Fantastic Reliability" of Car Engines

SIR, Mr. Gordon Wilkins on automobiles is always interesting and well-informed. There are two points in his recent Automobile Review on "Engine Changes in Britain and Abroad" (ENGNG., 20 Oct. '61, p. 502) on which I would like to comment.

He states: "improvements in filtration techniques have helped to make possible an extension of oil change intervals to 3,000 miles on many British engines, but American manufacturers have extended their oil change periods to anything from 4,000 to 6,000 miles." I bought my Ford Anglia seven years and 28,000 miles ago, and change the engine, gearbox, and axle oils at 5,000, as Ford recommend. Gearbox and axle oils always come out clean, and it seems a waste to do this at lesser intervals than 10,000 miles, as I shall do from now on, especially remembering the "sealed for life" axles on some American cars.

Again, he states: "Several American manufacturers have also adopted imp oved anti-freeze mixtures with inhibitors which allow them to be kept in the radiator safely for periods up to two years."

When my car was delivered I filled the cooling system half-and-half with a proprietary anti-freeze (from the blue can) and it has been there ever since, summer and winter, with no complaints from the radiator block, hoses, pump or thermostat. Now it starts its eighth year. Some correspondence with the vendors confirmed my idea that the ethylene glycol was permanent, and that only the rust inhibitor gave out. Anti-freeze mixtures raise the boiling point, as well as lower the freezing point, and the system is slightly pressurized anyway.

And, if it interests anybody, the top has never been off, nor the tappets adjusted, and the engine runs as new. The reliability of the modern automotive engine is fantastic. The tyres, only a little worn, all have the same air of seven years ago (touch wood!), the brake rivets are under-flush, and the original battery is still going strong. Not bad for £360.

Yours faithfully,

A. M. GUNNER.

Rugby.
20 October, 1961.

A New Kind of Typewriter

SIR, That IBM have produced an outstanding machine in their IBM 72 typewriter is evident ("Mechanics of a New Kind of Typewriter," ENGNG., 6 Oct. '61, p. 432). One feature specially stressed is the type head.

In fairness to some past genius, I should like to remind you of the type head used over seventy years ago in the Blickensderfer typewriter. In this case the head is cylindrical and rotates about a polar axis but rises and falls on the same axis to change from one row of characters to the other.

The head on my machine has a diameter of $1\frac{5}{16}$ in by $\frac{5}{8}$ in long, carries 84 characters, and can be changed for others with different characters, including a very neat hand written effect, by releasing a spring clip.

I would mention that the Blickensderfer type heads I have weigh $\frac{1}{4}$ oz and that the characters are slightly hollow in the centre to conform to the curvature of the roller. The type is inked by a small roller which the head strikes on its way down. It is, of course, the carriage which moves, not the head, for spacing. A drawback to the design is that it is difficult to see what one has typed.

My machine is one of two bought by my father about 1890. The keyboard is non-standard but has the most commonly used letters on the front, bottom, row of keys.

Incidentally, ENGINEERING is an old friend of mine as I used to read with great interest the bound volumes which my father kept, dating back to the time of the Tay bridge disaster.

Yours faithfully,

C. A. WYNNE.

Winchester,
Hampshire.
18 October, 1961.

Events in Advance

Lapping Exhibition

IN VIEW of the growing interest that is being shown in lapping machines, particularly in connection with their potentialities for the production of die castings for the motor industry, Payne Products International Limited, Buckingham Avenue, Slough, Berkshire, have arranged for an exhibition of some of their products at their Slough works. This exhibition will be held from 6 to 10 November and from 13 to 17 November next.

Among the machines to be demonstrated will be the new 72 in Lapmaster, which has been produced by the firm's American associates and which has been in use recently in the United States. This machine is stated to be larger than any other lapping machine now in use in Europe.

Other machines on show will include the British-made 48 in Lapmaster, in which are incorporated a number of improvements, and the British-made 24 in Lapmaster, which is a prototype. This machine also incorporates a number of innovations including a much improved method of applying the adhesive to the lapping plate.

Invitations to the exhibition may be obtained from the Press and Public Relations Department, Howard Panton Limited, Panton House, Howard Street, London WC2 (Telephone: COVent Garden 0231) or by applying to Payne Products International Limited at the address given above.

Exhibitions and Conferences

Arranged in chronological order

Scientific Instruments and Apparatus Exhibition, Annual.—Mon., 15 Jan., to Fri., 19 Jan., 1962, at the Royal Horticultural Society's Halls, Greycoat Street and Vincent Square, London SW1. Organized by the Institute of Physics and the Physical Society, 47 Belgrave Square, London SW1. Tel. BELgravia 6111.

Hotel and Catering Exhibition, International.—Tues., 23 Jan., to Thurs., 1 Feb., 1962, at Olympia, London W14. Organized by Hotel and Catering Exhibition (London) Ltd., 623-624 Grand Buildings, Trafalgar Square, London WC2. Tel. WHItehall 1371.

Furniture Exhibition, 13th Annual.—Mon., 29 Jan., to Sat., 10 Feb., 1962, at Earls Court, London SW5. Organized by B.F.M. Exhibitions Ltd., 17 Berners Street, London W1. Tel. LANgham 5115.

Amusement Trades Exhibition, 18th.—Tues., 30 Jan., to Thurs., 1 Feb., 1962, at the Royal Horticultural Society's New Hall, Greycoat Street, London SW1. Organized by Amusement Trades Exhibitions Ltd., 19 Charing Cross Road, London WC2. Tel. WHItehall 2524.

Furniture Fair, International.—Wed., 31 Jan., to Sun., 4 Feb., 1962, in Cologne. In the United Kingdom apply to the Du Mont Publicity Co., Ltd., 18 Queensberry Place, London SW7. Tel. KENsington 1700.

Toy Fair, Ninth British.—Wed., 31 Jan., to Tues., 6 Feb., 1962, at the Bedford, Grand and Metropole Hotels and the Corn Exchange, Brighton. Organized by British Toy Fairs (International) Ltd., 94 Hatton Gardens, London EC1. Tel. CHAncery 9158.

Gifts and Fancy Goods Fair, International.—Mon., 5 Feb., to Fri., 9 Feb., 1962, at Blackpool. Organized by Trade Promotion Services Ltd., St. Dunstan's House, Carey Lane, London EC2.

Meetings and Papers

The address and telephone number of the headquarters of each institution are given at the end of this list. Meetings in the headquarters town are held there unless otherwise stated.

Aslib

LONDON
"The Technologist," by R. Snel. Joint Meeting with Institute of Petroleum. 61 New Cavendish Street, W1. Wed., 15 Nov., 5.30 p.m.

Association of Supervising Electrical Engineers

BIRMINGHAM
"Kariba Dam Project," by H. J. Beard. Birmingham Branch. Engineering and Building Centre, Stephenson Place, Birmingham 2. Wed., 8 Nov., 7.30 p.m.

British Institution of Radio Engineers

LONDON
"Infra-Red Applications in Navigation," by C. M. Cade. Radar Group. London School of Hygiene and Tropical Medicine, Keppel Street, WC1. Wed., 15 Nov., 6 p.m.
BRISTOL
"Introduction to Analogue Computers," by P. G. Davies. South Western Section. College of Science and Technology, Ashley Down, Bristol 7. Wed., 15 Nov., 7 p.m.
LIVERPOOL
"Guidance of Bats and Men by Echo Location," by L. Kay. Merseyside Section. Walker Art Gallery, Liverpool. Wed., 15 Nov., 7.30 p.m.
PORTSMOUTH
"Recent Advances in Low-Noise Microwave Valves," by Dr. D. G. Kiely. Southern Section. College of Technology, Portsmouth. Fri., 10 Nov., 7 p.m.

Combustion Engineering Association

PORTHCAWL
"Shortcomings of Combustion Equipment," by Professor M. W. Thring. Western Region. Seabank Hotel, Porthcawl, Glam. Thurs., 16 Nov., 10 a.m.

Diesel Engineers and Users Association

LONDON
"Application of C.I. Engines to Cranes and Excavators," by G. A. Scott and J. K. Bellamy. Institute of Marine Engineers, 76 Mark Lane, EC3. Thurs., 16 Nov., 2.30 p.m.

Illuminating Engineering Society

LONDON
"Changes in Incandescent Lamps," by A. G. Penny; "A Standard Heat Test Lamp for the Temperature Testing of Lighting Fittings," by J. N. Bowtell and J. R. Coaton; and "Temperatures in Lighting Equipment with Incandescent Lamps," by J. Keen and H. F. Stephenson. Federation of British Industries, 21 Tothill Street, SW1. Tues., 14 Nov., 5.30 p.m.
GLASGOW
"The Mining Electrical Engineer Looks at Lighting," by J. Rae. Glasgow Centre. Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow C2. Tues., 14 Nov., 6 p.m.
MANCHESTER
"Lighting for Christmas," by E. P. Lee. Manchester Centre. Offices of the North Western Electricity Board, Town Hall Extension, Manchester 2. Thurs., 9 Nov., 6 p.m.
STOKE-ON-TRENT
"Lighting Journey Down the Rhine," by E. J. Smith. Stoke-on-Trent Group. North Stafford Hotel, Stoke-on-Trent. Mon., 13 Nov., 6.30 p.m.

Institute of Marine Engineers

LONDON
"Trials and Operation of the Gas Turbine Ship Auris," by R. M. Duggan and A. T. O. Howell. Tues., 14 Nov., 5.30 p.m.
ABERDEEN
"Elementary Nuclear Engineering," by H. F. Close. Scottish Section. Robert Gordon's Technical College, Aberdeen. Fri., 17 Nov., 7.30 p.m.
BATH
"The St. Lawrence Seaway," by J. C. G. Hill. West of England Section. Smith's Assembly Rooms, Westgate Buildings, Bath. Mon., 13 Nov., 7.30 p.m.
KINGSTON-UPON-HULL
"Marine Salvage," by Captain A. Lynas. Kingston-upon-Hull and Humber Section. Royal Station Hotel, Kingston-upon-Hull. Thurs., 16 Nov., 7.30 p.m.

Institute of Metals

GLASGOW
"Effects of Irradiation on Materials," by Dr. H. M. Finniston. Scottish Local Section. Institution of Engineers and Shipbuilders, 39 Elmbank Crescent, Glasgow C2. Mon., 13 Nov., 6.30 p.m.

Institute of Petroleum

LONDON
"The Technologist and His Information Facilities," by R. Snel. Joint Meeting with Aslib. Wed., 15 Nov., 5.30 p.m.

Institution of Agricultural Engineers

LONDON
"Use of Hydraulics in Agricultural Machinery and Farm Tractors," by H. J. Nation. Tues., 14 Nov., 6.45 p.m.
LINCOLN
"Soil Structure and Crop Production," by N. H. Pizer; and "Soil Cultivation," by Dr. P. C. J. Payne. East Midlands Branch. Riseholm Farm Institute, Lincoln. Tues., 14 Nov., 10 a.m.
NEWCASTLE UPON TYNE
Films on the "Use of Hydraulic Apparatus on Agricultural and Commercial Vehicles." Northern Branch. Offices of the North Eastern Electricity Board, Carliol House, Market Street, Newcastle upon Tyne 1. Mon., 13 Nov., 6.45 p.m.

Institution of Civil Engineers

LONDON
"Structural Problems in the Use of Cold-Formed Steel Sections," by A. H. Chilver. Tues., 14 Nov., 5.30 p.m.
"Overhead Pedestrian Ways"; Discussion, Introduced by J. W. Dark. Traffic Engineering Group. Thurs., 16 Nov., 5.30 p.m.

Institution of Electrical Engineers

LONDON
"Performance of Transistor Portable Receivers"; Discussion. Electronics and Communications Section. Wed., 15 Nov., 5.30 p.m.
"Design and Performance of High and Low-Voltage Terminal Boxes," by K. K. Schwartz. Utilization Section. Thurs., 16 Nov., 5.30 p.m.
"Electrical Accidents and Their Causes, Including the Legal Aspects"; Discussion, opened by S. J. Emerson. Mon., 20 Nov., 5.30 p.m.
BELFAST
"Portentialities of Artificial Earth Satellites for Radiocommunication," by W. J. Bray. Northern Ireland Centre. David Keir Building, Queen's University, Stranmillis Road, Belfast 9. Tues., 14 Nov., 6.30 p.m.
LIVERPOOL
"Electrical Requirements of General Cargo Docks," by E. R. Radway. Mersey and North Wales Centre. Royal Institution, Colquitt Street, Liverpool. Mon., 13 Nov., 6.30 p.m.
MALVERN
"Lighting for Monochrome Television Productions," by P. Catlett; and "Colour Television Production Problems," by I. Atkins. South Midland Centre. Winter Gardens, Malvern. Mon., 13 Nov., 7.30 p.m.
MANCHESTER
"Progress in Oil-Fired Cables and Their Accessories," by Dr. A. N. Arnam, Dr. Ing. F. J. Miranda and G. R. Bishop; and "The Influence of Ageing on the Characteristics of Oil-filled Cable Dielectric," by Dr. Ing. P. Gazzana Priaroggia, Dr. Ing. G. L. Palandri and Dr. Chem. U. A. Pelagatti. North Western Centre. Engineers' Club, Albert Square, Manchester 2. Tues., 14 Nov., 6.15 p.m.
NEWCASTLE UPON TYNE
"Electronic Analogue Computer Simulation of Multi-Machine Power System Networks," by Dr. A. S. Aldred; and "Analysis of Overall Stability of Multi-Machine Power Systems," by J. G. Miles. North Eastern Centre. Neville Hall, Westgate Road, Newcastle upon Tyne. Mon., 13 Nov., 6.15 p.m.
PORTSMOUTH
"A General Theory of Depreciation of Engineering Plant," by D. Rudd. Southern Centre. Offices of the Central Electricity Generating Board, High Street, Portsmouth. Wed., 15 Nov., 6.30 p.m.

Institution of Engineering Designers

NEWCASTLE UPON TYNE
"A National Standard in Engineering Design Education," by W. A. A. Whitham. North East Branch. Rutherford College of Technology, Northumberland Road, Newcastle upon Tyne. Mon., 13 Nov., 7.15 p.m.

Institution of Heating and Ventilating Engineers

BIRMINGHAM
"Structural Insulation of Buildings," by J. Lawrie. Birmingham Branch. Engineering and Building Centre, Stephenson Place, Birmingham 2. Tues., 14 Nov., 6.30 p.m.
CARDIFF
"Anthracite Fuels for Domestic and Industrial Boilers," by S. R. Crook. South Western Branch. GEC Building, Cardiff. Tues., 7 Nov., 6.30 p.m.
SHEFFIELD
"The Application of Unit Air Conditioners," by E. P. Johnson. Yorkshire Branch. Athol Hotel, Charles Street, Sheffield 1. Tues., 14 Nov., 7.30 p.m.

Institution of Mechanical Engineers

LONDON
"Automobile Air-Cooled Engines," by Julius Mackerle. Nominated Lecture. Automobile Division. Tues., 14 Nov., 6 p.m.
"The Influence of Gas-Inlet Temperature on Magnox Reactors"; Discussion. Nuclear Energy Group. Wed., 15 Nov., 6 p.m.
CHATHAM
"The Potentialities of Accurate Measurement and Control," by J. Loxham. Southern Branch. Sun Hotel, Chatham. Thurs. 16 Nov., 7.30 p.m.
EXETER
"Brake Linings"; Discussion. Western Branch. Rougement Hotel, Exeter. Fri., 17 Nov., 7 p.m.
NEWCASTLE UPON TYNE
"Pulsating Damping Systems for Reciprocating Compressors and Free-Piston Gas Generators"; Discussion, to be opened by Dr. F. J. Wallace. North Eastern Branch. Stephenson Building, Claremont Road, Newcastle upon Tyne. Thurs., 16 Nov., 6.15 p.m.
SWANSEA
"Formula for Spread in Hot Flat Rolling," by L. G. M. Sparling. South Wales Branch. Offices of the South Wales Electricity Board, Kingsway, Swansea. Tues., 14 Nov., 6 p.m.

Institution of Mining and Metallurgy

LONDON
"Determination of Silver in Lead Sulphide Concentrate by Atomic Absorption Spectroscopy," by B. S. Rawling, M. D. Amos and M. C. Greaves; and "Mining and Metallurgical Operations at Rhodesia Broken-Hill: Past, Present and Future," by K. C. G. Heath. Geological Society, Burlington House, Piccadilly, W1. Thurs., 16 Nov., 5 p.m.

Institution of Production Engineers

BIRMINGHAM
"Some Aspects of the Design of Machine Tools and Automation Equipment for the Future," by F. A. Lewis. Birmingham Section. James Watt Memorial Institute, Great Charles Street, Birmingham. Wed., 15 Nov., 7 p.m.
DONCASTER
"Synthetic Fibres Used in Engineering," by A. Lonsdale. Doncaster Section. Technical College, Waterdale, Doncaster. Tues., 14 Nov., 7 p.m.
HALIFAX
"Design and Development of Machine Tools," by C. A. Sparkes. Halifax and Huddersfield Section. Percival Whitley College of Further Education, Francis Street, Halifax. Mon., 13 Nov., 7.30 p.m.
SHEFFIELD
"Human Relations in Industry," by E. Fletcher. Sheffield Section. Grand Hotel, Sheffield. Mon., 13 Nov., 6.30 p.m.

Institution of Structural Engineers

LEEDS
"The Design of a Cantilever Stand for the Sheffield Wednesday Football Club," by H. C. Husband, T. Holmshaw and H. C. English. Yorkshire Branch. Department of Civil Engineering, The University, Leeds. Wed., 15 Nov., 6.30 p.m.
MANCHESTER
"Architectural Misconceptions of Engineering," by A. J. Harris. Lancashire and Cheshire Branch. College of Science and Technology, Manchester. Mon., 13 Nov., 6.30 p.m.

Institution of Water Engineers

LONDON
"Overland to the USSR," by F. Needham Green; and "Hold Back the Sea" (film). South Eastern Section. Institution of Civil Engineers, Great George Street, SW1. Wed., 15 Nov., 2.30 p.m.

Junior Institution of Engineers

LONDON
"Some Notes on Early Marine Diesel Engines," Chairman's Address, by E. E. Burrage. Fri., 17 Nov., 7 p.m.

Reinforced Concrete Association

BIRMINGHAM
"Architectural Aspects of the Design, Detailing and Execution of Reinforced-Concrete Shells," by H. S. Scorer. Midland Counties Branch. Birmingham and Midland Institute, Paradise Street, Birmingham. Tues., 14 Nov., 6 p.m.

Royal Institution

LONDON
"Air Flow and Wings," by Professor W. A. Mair. Fri., 17 Nov., 9 p.m.

Royal Institution of Chartered Surveyors

LONDON
Presidential Address, by E. C. Strathon. Mon., 13 Nov., 5.45 p.m.

Royal Meteorological Society

LONDON
Various short papers. Wed., 15 Nov., 5 p.m.

Royal Society of Arts

LONDON
"Engineering and Architecture," by Professor Ing. Riccardo Morandi. Wed., 15 Nov., 6 p.m.

Sheffield Metallurgical Association

SHEFFIELD
"Properties and Fabrication of Some of the Newer Metals," by Dr. N. P. Inglis. BISRA Laboratories, Hoyle Street, Sheffield. Tues., 14 Nov., 7 p.m.

Society of Chemical Industry

LONDON
"Science of Corrosion"; General Discussion, to be opened by C. Edeleanu, E. Ll. Evans, J. F. Kayser and J. N. Wanklyn. Wed., 15 Nov., 6 p.m.

Society of Instrument Technology

LONDON
"Digital Techniques for the Study of Sea Waves, Ship Motion and Similar Processes," by D. E. Cartwright, M. J. Tucker and Miss D. B. Catton. Data Processing Section. Manson House, 26 Portland Place, W1. Thurs., 16 Nov., 7 p.m.
BRISTOL
"Instrumental Control at Low Temperatures," by Dr. R. G. Chambers. Bristol Section. Department of Physics, Bristol University, The Royal Fort, Bristol 8. Wed., 15 Nov., 7.30 p.m.

South Wales Institute of Engineers

CARDIFF
"Some Problems of Shaft Inset and Pit Bottom Roadway Construction at Abernant Colliery," by T. Vaughan Thomas. Thurs., 16 Nov., 6 p.m.

West of England Metallurgical Society

BRISTOL
"Teaching Metallurgy to Metallurgists and Engineers"; Discussion, to be opened by Professor J. G. Ball and L. W. Derry. College of Science and Technology, Bristol 7. Tues., 14 Nov., 7 p.m.

West of Scotland Iron and Steel Institute

GLASGOW
Various short papers on "The Marking, Cutting and Testing of Steel." Thurs., 16 Nov., 6.45 p.m.

Aslib (Association of Special Libraries and Information Bureaux), 3 Belgrave Square, London SW1. (BELgravia 5050)
Association of Supervising Electrical Engineers, 23 Bloomsbury Square, London WC1. (LANgham 5927)
British Institution of Radio Engineers, 9 Bedford Square, London WC1. (MUSeum 1901)
Combustion Engineering Association, 70 Jermyn Street, St. James's, London SW1. (WHItehall 5536)
Diesel Engineers and Users Association, 18 London Street, London EC3. (ROYal 2393)
Illuminating Engineering Society, 32 Victoria Street, London SW1. (ABBey 5215)
Institute of Marine Engineers, Memorial Building, 76 Mark Lane, London EC3. (ROYal 8493)
Institute of Metals, 17 Belgrave Square, London SW1. (BELgravia 3291)
Institute of Petroleum, 61 New Cavendish Street, London W1. (LANgham 3583)
Institution of Agricultural Engineers, 6 Queen Square, London WC1. (TERminus 0140)
Institution of Civil Engineers, Great George Street, London SW1. (WHItehall 4577)
Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London WC2. (COVent Garden 1871)
Institution of Engineering Designers, 38 Portland Place, London W1. (LANgham 8847)
Institution of Heating and Ventilating Engineers, 49 Cadogan Square, London SW1. (SLOane 3158)
Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, London SW1. (WHItehall 7476)
Institution of Mining and Metallurgy, 44 Portland Place, London W1. (LANgham 3802)
Institution of Production Engineers, 10 Chesterfield Street, London W1. (GROsvenor 5254)
Institution of Structural Engineers, 11 Upper Belgrave Street, London SW1. (SLOane 7128)
Institution of Water Engineers, Parliament Mansions, Abbey Orchard Street, London SW1. (ABBey 6740)
Junior Institution of Engineers, Pepys House, 14 Rochester Row, London SW1. (VICtoria 0785)
Reinforced Concrete Association, 94-98 Petty France, London SW1. (ABBey 4504)
Royal Institution, 21 Albemarle Street, London W1. (HYde Park 0669)
Royal Institution of Chartered Surveyors, 12 Great George Street, London SW1. (WHItehall 5322)
Royal Meteorological Society, 49 Cromwell Road, South Kensington, London SW7. (KENsington 0730)
Royal Society of Arts, John Adam Street, Adelphi, London WC2. (TRAfalgar 2366)
Sheffield Metallurgical Association, 64 Crescent Road, Sheffield 7 (Sheffield 52865)
Society of Chemical Industry, 14 Belgrave Square, London SW1. (BELgravia 3681)
Society of Instrument Technology, 20 Queen Anne Street, London W1. (LANgham 4251)
South Wales Institute of Engineers, Park Place, Cardiff. (Cardiff 23296)
West of England Metallurgical Society. Apply to Mr. P. C. Thornton, College of Technology, Bristol.
West of Scotland Iron and Steel Institute, 39 Elmbank Crescent, Glasgow C2. (Central 5181)

Human Element

BIM in the New Industrial Revolution

TORQUAY out of season was the setting for last week's sixteenth National Conference of the British Institute of Management. The theme of the conference, "Management in the New Industrial Revolution," was a reminder that management thinking cannot stand outside the technical, educational, political and sociological changes around it.

On the Tuesday evening, the delegates assembled to hear the opening address by Mr. Paul Chambers who, as chairman of ICI, was probably one of the topmost of the 400 top and middle managers present at the conference. Mr. Chambers began his paper in a "never had it so good" vein that suggested, for a moment, that he might have borrowed the Prime Minister's scriptwriter.

Then, just as one was beginning to wonder why 400 managers had bothered to come to Torquay at all if things really were so rosy in their own backyards, Mr. Chambers brought us back to reality by describing how we are living on borrowed time in failing to keep our increase in productivity in line with our increase in consumption. Since 1950, our growth in national product per man-year has been 1·7 per cent compared with 6·1 per cent in Japan, 4·7 per cent in Italy, 4·5 per cent in Western Germany, 3·6 per cent in France, and 2·2 per cent in the USA.

In short, our record relative to other countries is a poor one which is making us dangerously uncompetitive. This situation, now being brought to a head by our impending entry into the Common Market (a prospect which Mr. Chambers welcomed, as forcing us to become competitive), presents management with the problem of, and responsibility for, making industry more efficient. Mr. Chambers abhorred Government policies which shield inefficient firms.

Forecasting

On the other hand, he was for the raising of surtax levels (a safe opinion, perhaps, at a gathering of top managers and, more important, prospective top managers) and for economic forecasting, as necessary stimuli to management. On this latter question, he gave the important advice that firms should cooperate with requests from outside bodies for economic information because "it may better serve the narrower interest of the firm to take a wider view of the public interest." The French have a word for it.

Convinced by the opening address (where convincing was still necessary) that industry, and therefore management, is in the throes of a revolution that must now gather momentum, the delegates spent the next two days in a concentrated round of papers and discussion. Virtually every facet of industrial activity was scrutinized in terms of management problems. These facets included management training and succession, the implications of technical change, human relations, the particular problems of big and of small firms, research and development, marketing and, of special significance now that genuine economic planning seems to be in the air, the relationship between government and industry.

The Lonely Manager

One of the two plenary sessions of the conference was addressed by Mr. Robert Appleby, managing director of Black and Decker, on "Management, People and Productivity." Mr. Appleby painted a picture of the manager as a very lonely man, unhelped and unloved by the government and the trade unions alike. This seemed to be a cynical, if sometimes understandable, picture.

As far as government action is concerned, it is true that the patience of management has been tried severely by "stop-and-go" economic policies. As Mr. Appleby put it, "In the sixteen years since the end of the war there have been nine major changes in the rate structure of purchase tax, and ten major changes in hire purchase controls . . . (and) eight Chancellors of the Exchequer."

As to the trade unions, he saw a fundamental dichotomy of interest (though not as big at it used to be) between them and management on "such broad issues as wages and conditions of work, management authority and union rights, and the division of the profits of productive enterprise."

However, though one might disagree with Mr. Appleby about the help the manager can expect from other quarters, there was no doubt that he was right on the ball when he went on to say that "the wages structure and conditions of employment in many industries are now so complicated that they cannot be understood by the ordinary man or manager. The engineering industry has probably suffered more in this way than most others.

Turning to the fields in which he felt that management could profitably go it alone, if necessary, Mr. Appleby suggested three areas of management activity where significant improvements could be made. These were (*a*) through better management practice; (*b*) through improvement in relationship with work people; and (*c*) through provision of better rewards for work people.

Under the first of his headings, "better management practice," the speaker advocated an extension of the use of standard costing and management accounting. Management organizations and structures should also be examined to ensure that they "maximize local initiative while safeguarding the best interests of the enterprise at the centre."

At his second point of attack, management's relationship with the work people, the speaker considered that there should be wider recognition of the foreman as the manager who implements management policy. Management must get back into closer touch with the shop floor and must make more information about their companies available to employees. He contrasted the vast sums spent on selling the products of industry to the consumer with the sum spent on selling the company and its policies to the employees. In the last resort, though, said Mr. Appleby, management cannot have good industrial relations without winning the respect of the shop floor, and the only way to do this is by competent management. In this, of course, he was absolutely right; the British workman is one of the world's best detectors of humbug.

Talking about his third proposed way of improving productivity, through better rewards for employees, the speaker was against work measurement and for merit rating. This advocacy of merit rating seems to be a growing trend in present day management thinking, though, of course, some firms (ENGNG., 7 July, p. 20) have used both work measurement and merit rating, the former for costing and planning purposes and the latter as a basis for payment. Mr. Appleby also thought the device of the stock option should be used more, so that "the rewards of capital appreciation and ownership could reach the shop floor."

Management Education and Training

The recommendations of the Heyworth Committee and the recent correspondence in *The Times* had possibly stimulated advance interest among the delegates in the papers on management training. New trends in management training within industry were described by Mr. A. G. P. Elliott, a director of Standard Telephones and Cables.

He showed how, during the past ten years, more formal training schemes have been introduced, and how some of these have been tailored to suit middle management training. This extension of training to middle management (and, in one or two cases, to top management) has been one of the newer phenomena in training and seems to have been a product partly of benefiting from American experience and partly of the influence of former junior management trainees who have now worked a few rungs up the ladder. Another fairly recent trend in management training is the advent of statistical methods, sometimes with the use of computers.

As management thinking adapts itself to technical and other changes around it, so management training is beginning to call in question some of the classical concepts, such as span of control. Management training, in fact, is growing in volume and becoming both deeper and wider.

Training aids are also developing. From the case study has come its shorter derivative, the incident method. Since the mid-50s the business game, incorporating the element of chance, has been developed together with a variation on it, the in-basket technique. Stimulation techniques are also a feature of some training programmes.

An interesting recent development, related to the growing concept of integrated management, is the method of group dynamics, sometimes called sensitivity or group relations training. On-the-job training is becoming fashionable again, with the emphasis on planned development by assigning a man to a series of operational jobs of different types. All in all, Mr. Elliott's conclusion was "that management training is here to stay."

Mr. W. J. Willett, of Cambridge University, talked to the conference about new trends in management training on external courses. He described two courses now running at his own university, one of them an immediate post graduate course for men with little or no industrial experience and the second, run in conjunction with Churchill College, for men who are already in management jobs. He referred, too, to experimental courses in management education at Bristol, Leeds, Glasgow, Edinburgh and Oxford, and suggested that this new dynamism might, with the support of industry, lead to marked changes in management education and, perhaps, in management.

Another paper which was very much relevant to the question of management education and training was the paper on "Management Succession," given by Mr. L. S. Newton, Group Education Officer of Pilkington Brothers.

Government and Industry

The relationship between government policies and industry was covered by Mr. Hugh Weeks, C.M.G., director of the Industrial and Commercial Finance Corporation and of the Finance Corporation for Industry. After reviewing the clumsy tools at present at the Government's disposal for dealing with our recurring balance of payments crises, Mr. Weeks talked about our disappointing economic growth in relation to other countries.

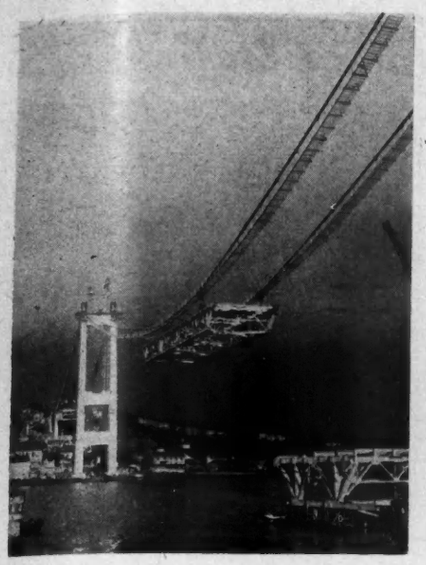
In particular, he dealt with the French success in achieving planning by consent (ENGNG., 13 Oct., p. 470). For many of us, it has been something of a shock to discover that not only West German freedom, but also French planning, pays. The French Four-Year Plans, whereby the different sectors of industry put forward their proposed expansion plans to be integrated in an overall national plan, seems to be an amazing piece of mass diplomacy. It is a monumental task to have been able to draw up three such plans on this basis, but to have carried two of them through (the third has only just started) without any one firm or industry jumping far enough out of line to unbalance the whole plan, has been the economic *tour de force* of post-war Europe.

Perhaps it all comes back to Mr. Chambers' point about firms finding the giving of economic information for the public interest to be, in fact, in the narrower interest of the company.

Quo Vadis?

Two papers—that by Sir Leonard Owen, C.B.E., of the United Kingdom Atomic Energy Authority, on "Management and Technical Change," and that by Mr. L. Landon Goodman, of the British Electrical Development Association, on "Management and Automation"—stressed the necessity for management thinking and practice to keep pace with technical change. Mr. Goodwin saw this as part of a broader need for scientists and technologists to contribute to leadership, not only in industry, but socially and politically.

It is usually difficult to know how far the pious hopes expressed at conferences of 400 people will ever be translated into action. On this occasion, however, there seemed to be an encouraging sense of urgency about the delegates.



(*Above*) *The first of the deck steelwork in position.*

(*Right*) *The Tamar road bridge linking Devon and Cornwall is now open to traffic.*

Tamar Bridge Completed

Reinforced concrete towers and locked coil ropes are unusual features of Britain's new suspension bridge.

THE Tamar Bridge is the first suspension bridge to be completed in Britain for 66 years; it is also the longest of its type—1,100 ft between the towers—in the country and will remain so until the Forth Bridge is completed in 1963. The bridge was opened to road traffic on 24 October. It is a toll bridge, has cost £1¼ million and was built without the aid of a Government grant. The bridge joins St. Budeaux in Devon to Saltash in Cornwall at a point five miles from Plymouth, and is adjacent to 102 year old Royal Albert Bridge built by Brunel. It replaces a slow, small capacity chain ferry which has been the cause of many traffic queues in holiday traffic going to and from Cornwall.

Traffic is carried on a three-lane carriageway 33 ft wide, with a 6 ft wide footpath at each side. The roadway is 130 ft above the spring tide high water mark. In addition to the central span of 1,100 ft there are two side spans of 374 ft, making the total suspended length 1,848 ft. The reinforced concrete towers are 250 ft high.

The main towers were built on concrete piers, caissons having been sunk to an average depth of 36 ft below river bottom prior to building the piers; compressed air was used to prevent flooding and about 5,000 tons of fill was required to fill the bunds. Each tower consists of two hollow reinforced concrete columns linked by two double concrete webs below the road level —one pair at mid-height between the river level and the road and the other supports the road—and a third web joins the tops of the columns. Each of the columns is 14 ft square in section at the base and tapers to 9 ft square at the cap. Reinforced concrete for the towers of suspension bridges is still relatively novel, the first notable example being the Tancarville Bridge opened over the Seine in August, 1959.

Construction of the towers was carried out using four P25 Pignon climbing cranes, two to each tower. A peculiar difficulty arose in this case because the cavity within each tower was not sufficient to accommodate the crane, so the normal type of climbing crane was replaced by one made of bridging sections fixed between the inner faces of the columns and below the lower web, the cranes themselves being erected outside the columns. To save the jibs fouling each other, it was necessary for one crane in each pair to be erected with its fixed jib above that of the other. As, also, the cranes were not called on for the full outreach of which they are capable—99 ft—only the root element of each jib was assembled, giving a maximum working radius of 27½ ft and a top load of 2½ tons. This shortening of the jibs allowed the lower crane to slew through a full circle without fouling the tower of the other.

The formwork for the towers was obtained from Kwikform Limited and the columns were placed in 10 ft lifts. A batching plant of 1 cu. yd capacity was set up at the base of each tower. The cranes were used to raise the steel reinforcement, the formwork, concrete skips, and later handle the cable equipment and lighter sections for the steel deck.

Supporting the deck structure are two main cables, each comprising 31 separate steel ropes. Each rope is 2,200 ft long and weighs nearly 14 tons, so that the two cables have a total weight of about 850 tons. The ropes were made by British Ropes Limited of Doncaster and are of the locked coil pattern, a type of rope not known to have been previously used in suspension bridge construction.

Extremely close tolerances were specified for the ropes. Each rope was required to be 2,370 $\pm$ 0·0025 in in diameter under no load and to have a breaking load in excess of 334 tons. After prestressing and suspended under its own weight it was required to have a diameter of 2·365 in and when suspended with a load of 100 tons, the maximum working load, 2·631 in. The resultant torque had to be nil or as small as possible. After a series of prestressing tests to 50 per cent of the ultimate load, the ropes were measured off to the correct length and end sockets fitted under a load of 100 tons. The assembly was then again proof loaded to 167 tons, the load reduced to 100 tons and the length checked before acceptance.

To erect the catwalks required for slinging the main cables between the towers and down to the anchorages, ropes were first put into position and then battens with side clips running over the ropes, and carrying a floor mesh, were allowed to slide down from the tops of the towers towards mid-span and to the anchors. The clips were crimped to the ropes, vertical side battens put up and hand ropes run into position, to complete the catwalks.

Angle iron head frames were built at seven points along each catwalk to hold the sheaves for the aerial haulage rope. The haulage rope was continuous over both cable runs, extending from a surge drum on the Plymouth side, along the north catwalk, round a tensioning device on the Saltash bank, back across the south catwalk, to another tensioning device and to the drum; the rope ends were spliced together.

Plate carriers were fastened to the haulage rope at the Plymouth north and the Saltash south anchorages. Thus, as one carrier carried a main cable rope over from the Plymouth side (where the ropes were stored) the empty carrier returned across the other catwalk. The ropes were first fastened "short" so that they hung clear of their final position and allowed to reach a steady uniform temperature; the holding nuts were then slackened and the cable allowed to settle into its correct seating, the interstices being injected with a bituminous compound to provide a water seal. With the 31 ropes in position, six aluminium filters were used in the corners to complete a circular cable of 14$\frac{11}{16}$ in diameter. The cable bands were lowered down the main cables from the tower heads and fixed at points previously marked on the No. 1 rope during prestressing.

The 120 suspender ropes were made to the same specification as the main ropes, but were only 2·085 in diameter with a breaking load of 246 tons. They were prestressed and measured and cut to length with a tolerance of $\pm\frac{1}{8}$ in.

The central span was built up from 80 ton prefabricated sections floated out into the stream on pontoons and raised into position beneath the main cables by winches. The overall depth of the deck girders is 18 ft; the concrete road slab is 6 in thick with a topping of asphalt 1½ in thick. The main cables are now being wrapped with galvanized wire.

The principal contractor for the bridge has been the Cleveland Bridge and Engineering Company of Darlington, and the consulting engineers Mott, Hay and Anderson of London. Though now open to traffic, the bridge will not be officially opened until next spring.

Glulam Raker Beam Carries Four Flights of Stairs

A feature of the new Peter Robinson store in Bristol is the central laminated timber staircase which rises approximately 27 ft from ground to second floor level in four flights.

Each of the four flights is supported on a single central laminated raker beam fabricated from ¾ in European Redwood laminae glued with Casco Casein glue made by Leicester, Lovell and Company Limited, North Baddesley, Southampton.

The raker beam from ground floor level to the first landing is housed into a second beam that serves the flight of stairs from the landing to the first floor. A curved laminated member, shown in the illustration, acts as a supporting bracket for the first landing and sweeps from the base of the supporting stump positioned below the point of intersection. The two beams which serve the flights from first to second floor levels are independent of each other.

Mild steel metal brackets carry the treads and these are welded to central spine steel plates which run the lengths of the top sides of each raker beam. The treads, laminated from Afrormosia laminae, are approximately 13½ in wide, and taper from a maximum depth of 2 in at the centre to a minimum of 1½ in at each of the ends. Altros Safety Inserts are incorporated into each tread to provide non-slip nosings.

The first landing, measuring 14 ft 6 in by 10 ft 2 in and fabricated from softwood, is fixed to the carriage beam with countersunk coach screws. A feature of this landing is the blue Filon fibreglass panel let into the floor and lit internally by fluorescent lighting tubes. The remaining area is covered with Accoflex tiles. The underside of the landing is covered with painted ¼ in Gaboon plywood. The surrounding fascia of the landing is laminated from Afrormosia and this wood is also used for the laminated guardrail. Samuel Elliott and John P. White (Reading) Limited fabricated the wreaths, ramps and quadrants of the guardrail by bending the laminae around drums, the final finishing operations being done by hand.

The handrail is of unusual construction; it consists of a core of black industrial pvc material faced on both sides with Afrormosia veneers. As with the guardrail, the acute radii of the ramps, wreaths and knees were formed by bending the veneers around drums during fabrication.

The curved laminated member which sweeps from the base of the supporting post to the first landing.

Bonding Concrete with Epoxy Resins

Ever since Portland cement concrete was first used, the problem of restoring cracks and spalls in concrete structures has proved a bugbear. Particularly baffling has been the problem of bonding new concrete to old. A variety of adhesives have been used from time to time, but with indifferent results. At this year's Building Exhibition at Olympia, London, there will be a range of new products marketed for the first time in this country by Cementex (UK) Company, of Orpington, Kent, and will be on show at the Cementex stand.

These products are based on epoxy resins. When a hardener is added, the resin sets at normal temperatures to a tough and durable plastic. The addition of other resins can produce a plastic alloy which is inherently tough and resistant to water and chemicals.

Another remarkable property of these alloys is a zero shrinkage factor. They contain no evaporants, and retain their total bulk on hardening. They are thus ideal for securing even surfaces. In addition, they are unusually sound absorbent and a low K factor gives them a high value as thermal insulators. They may be painted, or treated with pigments for such purposes as decoration or the incorporation of traffic markings in the road surface. They can be made self-extinguishing where fireproofing is desirable.

Epoxy alloys are used in a wide range of applications, and this range is increasing rapidly. They are used, for instance, in the repair and restoration of a wide variety of concrete structures subject to cracks, spalling and porosity. They are also widely used for waterproofing, construction of non-skid road surfaces and pavements, as well as for bonding operations such as tile setting, facing walls, grouting bolts and reinforcing rods, underlayment and fixing precast sections.

The epoxy products on show at the Cementex stand are:

Epoweld 820: When strewn with silicon carbide or other hard grain material, Epoweld gives skid-free industrial flooring and gangways. It is also used as a protective coating in water tanks and swimming pools. This material gives a hard repellent surface which is easy to clean. It offers full resistance against diluted organic acids and alkalis, as well as against many solvents. Application may be by spray gun, brush or rubber squeegee.

Epoweld 830: Applied in two layers and strewn with sand, this product can be used both as a skid-free surface for concrete or wooden bridges. It may be employed as a protective coating for asphalt surfaces liable to petrol and oil spillage. Application as above.

Epoweld 812: An anchoring layer in the application of new concrete to old. The joint can take very high stresses and is actually stronger than the concrete itself. Used with a filler such as dry sand, it provides a medium for the restoration of cracks in concrete, as on runways. It is applied with a bristle brush or steel spreader.

Epoxicrete 811: Used as a surfacing material in thicknesses of ⅛ to ¼ in where there is extremely hard wear, and where the emphasis is on the resistance to solvents, alkalis, and acids. It retains a degree of elasticity under extremes of weather and is best applied with a steel trowel.

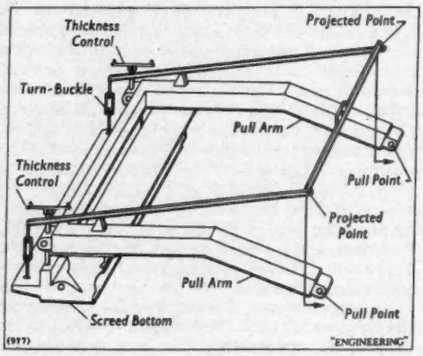
AB Svensk Blacking Industri, Orebro, Sweden. Cementex (UK) Company, Orpington, Kent.

Two-Way Control for Bituminous Pavers

In a report entitled "Longitudinal and Transverse Control for Bituminous Pavers," by Mr. F. M. Drake, published by the United States Highway Research Board (Bulletin 280), the author states that recent developments for these pavers have all been directed towards faster operation and greater power and output, and ignore the transverse and longitudinal levelling capabilities. He continues, "There is no positive control in either of these two directions."

Continuing with his description of general practice in the United States, the author goes on to say that with machine-laid methods of construction, the levelling is accomplished by skin patching of the initial surface, but due to the thinness of the material involved it is difficult to produce a satisfactory surface. It is possible, he says, to fit to all pavers a crown or gradient indicator fitted to the screed at the rear of the machine, making use of the surface that has already been laid as guide. Pavers may also use an auxiliary screed or roller extending backward from the floating screed to extend the length of the effective action of the machine. These two attachments serve only to reduce regularities over short distances. The author comments that few machines in his experience are fitted with even these limited adjustments.

The paper continues with a description of a device, shown diagrammatically in the illustration, which Mr. Drake has used in the work of the Kansas State Highway Commission, and he adds, "To say that these controls have produced gratifying results is putting it mildly. Sagging and bulging centre lines and scalloped edges have been replaced by long graceful lines."



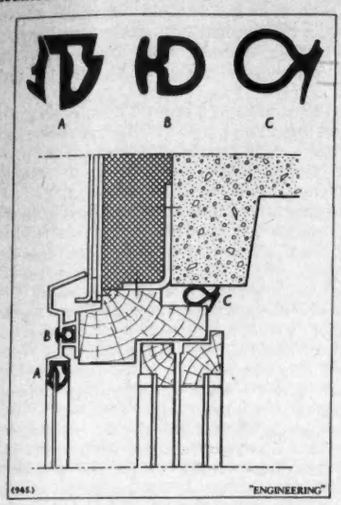
Offset linkage to provide level control for bituminous pavers.

The attachment is quite simple and basically consists of no more than an elementary linkage duplicated on the two sides of the machine, supplemented by height adjustments—shown as turnbuckles in the drawing—for the screed. Forward of the screed, and above the pulling point, there is what the author terms the "projected point" of the linkage. The operators control the machine so that these points closely follow control lines laid down in advance of the work; the author indicates that he has successfully employed taut string lines as the controls. Hitherto, the paver manufacturers have recommended that, to obtain a smooth gradient, the machine should not be "over controlled"; in contrast, the author's procedure demands that the machine should be adjusted as frequently and rapidly as may be necessary to follow the control lines.

Highway Research Board, 2101 Constitution Avenue, NW, Washington 25, DC, USA.

Extruded Seals Reduce Installation Costs

The new radio and television centre in Stockholm has evacuated seals in the glazing and curtain wall installations; their use is claimed to have saved 10,000 working hours. The EFAB seals are made of hollow extrusions of neoprene synthetic rubber. The plain tubing is first evacuated and fitted into position; it is then



Examples of the EFAB evacuated seals made of neoprene extrusions.

punctured so that air is allowed to enter and the tube expands forming a tight seal. Seal widths from 11 to 20 mm of the type illustrated were used but any desired shape can be made. In all, 381,000 ft of the seal were employed for the concrete blocks, curtain wall pannelling, internal joints between the wall elements and external glass panels. The seals need no adhesives when caulking, making them easy to install in bad weather conditions, and they are capable of maintaining a seal in spite of some structural movements.

The suppliers of EFAB seals are Aktiebolaget Aldo, Vanadisvägen 24, Stockholm Va. The United Kingdom agents are Machinery (Continental) Limited, 42 Park Street, London W1.

Protecting Timber in Cooling Towers

Induced draught cooling towers at Grangemouth recently underwent severe attacks of "soft" and "white" rot. Millions of gallons of hot water cascade through the towers each day and they are subject to two main damages—"soft rot," which works inwards from the surface to the centre of the wood, and "white rot," which works down through the centre of posts and beams, leaving a layer of sound wood on the outside. Any part of the structure that has been seriously affected is now being replaced by timber that has been pre-treated under pressure.

It has been found that an adequate safeguard is given by an impregnation of 0·4 lb of copper per cu. ft of timber. The treatment to the remaining affected areas consists of spraying the surface with copper sulphate and then sodium chromate. The second spraying fixes the copper sulphate and leads to the necessary insoluble deposit of chromate remaining in the timber. Precautions have been taken to prevent the copper entering into the circulating water, which would have caused serious corrosion of iron and steel in the plant. Three weeks after the tower had been treated and put on full load the timber was tested to estimate the amount of copper retained. The average deposit in timbers of thin cross section was 0·411 lb per cu. ft of copper sulphate, and in the larger timbers 1·25 lb per cu. ft; in both cases, this exceeded the minimum required.

Richardson and Starling Limited, Winchester.

Two Irrigation Schemes for India

The £26¼ million Parambikulam-Aliyar project was inaugurated by Prime Minister Nehru last month. The project will utilize the streams of the Anamalais which flows into the Arabian sea. There will be irrigation facilities for 240,000 acres in the Coimbatore district and an additional 180 MW of power production for the Madras grid. The scheme, which should be completed by 1965, is expected to increase the yield of paddy by 24,000 tons, of cotton by 80,000 tons and dry crops by 48,000 tons.

On October 11 the first waters of the Rajasthan canal were released for rabi sowing. This £150 million project is designed to turn a dust bowl of over 3·6 million acres into a productive area. About half of the 134 mile long Rajasthan feeder sec ion of the canal project in the Punjab and Rajasthan territories has been completed and other smaller feeders are nearly finished. In addition, excavations and compaction works have been completed for the first 14 miles of the 425 miles main canal.

Timber Preservation Using Re-heat

The efficient preservation of timber is dependent more on the method of application and the quantity of preserving agent used per unit of surface area or volume than the nature of the agent employed, according to a Forest Products Research report entitled *Non-Pressure Methods of Applying Wood Preservatives*, by J. Bryan and D. F. Purslow (HM Stationery Office, 2*s* 6*d*).

Preservatives are divided into three main groups: tar oil, organic solvent and waterborne, and there are many forms of these on the market made for application by either brushing, dipping or steeping. The penetrating power of the tar oil or organic solvent type depends mainly on its viscosity—a preservative of low viscosity will penetrate deeper into wood under similar conditions than one of higher viscosity.

It is desirable for the moisture content of the wood to be below 30 per cent, especially over the first inch inwards from the surface and the preservative should not be applied while the surface is wet. Before treatment outer and inner bark should be removed, since both are impervious to preservatives.

Immersion treatments are more economic than brush or spray application when there is a large supply of timber to be treated, though larger quantities of preservative are used. The rate of penetration and absorption are rapid at first, but after about ten minutes any additional time causes only a fractional improvement.

To obtain effective impregnation by a simple immersion treatment, the timber must often be left in the liquid for long periods. Better results have been obtained in 24 hours by the hot and cold open tank process. The tank is open to the atmosphere and the pressure difference is brought about by temperature variations. A piece of wood in seasoned condition contains minute air spaces totalling 45 to 70 per cent of its volume. If the wood is immersed in a liquid which is then heated, much of the air is expelled, partly by thermal expansion but mainly by the increase in the vapour pressure of the water in the wood. On cooling, the remaining air contracts and the vapour pressure of the water falls, creating a partial vacuum, and the liquid is drawn into the wood: thus most of the absorption takes place during the cooling period. The greater the difference of temperature, the greater the absorption.

A more effective method is to reheat the preservative after it has cooled and remove the timber after it has been kept in the hot preservative for one to three hours. By this method maximum penetration occurs during the cooling period and a large proportion of the absorbed preservative is expelled during the reheating. Most of the rejected preservative comes from the sapwood which initially takes up an unnecessarily large quantity, but the amount expelled by the heartwood is relatively small. The method of treatment is essentially the same for all species, but the optimum times and temperatures vary.

Translucent Panels for Ceilings

A new form of translucent panelling has been developed. "Thermalucent" ceiling, made by Isora, consists of two layers of thin pvc mounted on to a lightweight mild steel frame and separated by an air space of 1 in. The pvc film used is in the "self-extinguishing" fire category. One feature of the panelling is that the collection of dust and litter on the top panel is concealed by the gap between the films.

The ceiling consists of an attractively styled supporting grid of 18 swg hot-dip galvanized steel with V-shaped bottom flanged to all sections. This design reduces the apparent width of the supporting sections and avoids the appearance of dark lines across the ceiling. A wide range of pvc films is available, including coloured, printed, translucent and opaque patterns. The standard module will be 3 ft 4in, and the average cost will be approximately 7*s* 6*d* per sq. ft. This new product will be introduced at the Olympia Building Exhibition.

Isora Illuminating Ceilings Limited, Bedford Avenue, Slough, Bucks.

New Portable Site Office

A new version of the contractors' site offices has been introduced by Portasilo Limited.

The Portakabin is constructed as a single unit of resin bonded plywood, and is fully equipped for immediate use on arrival at the site. It is permissible to stack them one on top of the other into a three-storey block, or it may be raised by crane from floor to floor as a new building is erected. As shown in the illustration, telescopic legs and a jacking mechanism make it possible for one man to unload it from a lorry, taking only 15 minutes. Adjustable louvred

Unloading a Portakabin.

windows are fitted and there are electricity and telephone adaptors for immediate connection. The doors are split in a stable design.

There is a range of specially designed fittings to make the Portakabin suitable for a variety of uses, including management or general offices, or as a canteen for 18 to 24 people.

Portasilo Limited, Blue Bridge Lane, York.

Last week, p. 553, we referred to "Unistruct" inserts used in the Shell Centre. These should have been "Unistrut" inserts, made (as stated) by Sankey-Sheldon Limited.

The European Pattern of Electrical Power

With the exhaustion of the hydro-potential, a major natural source of electric power runs out in Europe. Continually growing power demands emphasize the value of reciprocal interchange of current across frontiers and underline the dilemma of internal transmission or local generation.

It is not as strange as may seem at first sight that the electric energy requirements of the European countries have knit them together complementarily to some extent, for the geographical juxtaposition of highly developed states could thus be played off to their mutual advantages. Power now flows to and fro across frontiers (and soon across the Channel between Britain and France): but as geography played into the hands of what seems nowadays to emerge as an economic union, so geophysical effects have visited the caprice of available hydro-electric resources to the advantage of some more than others—a degree of imbalance now tending to be smoothed out by the intervention of international electric supply systems and by the approaching exhaustion of water power resources.

NATIONAL RESERVES

Whatever the European countries may arrange in or between themselves in the way of power transmission and exchange, they remain each one responsible for solving their own problems of the highest and most efficient realization of generation resources—it is of obvious benefit for any state to strive for self-sufficiency, if not economic superiority. And developments in one direction may need to be followed by new techniques in quite another. But persisting throughout overall inquiry is the study of the flows of water throughout a continent. Water power may have appeared to confer advantages with unfair partiality, but it is found that a joint assessment of this disposition, now a more tenuous blessing, is for the common good.

Some of these problems were touched on at the twelfth Congress of the International Union of Producers and Distributors of Electrical Energy which took place at Baden-Baden in October. At the present state of development of electrical power transmission in the broad sense, differences of opinion have arisen respecting the justification of further interconnection in view of financial comparisons with other approaches. The chairman of the international interconnections committee of the Congress, Dr. Riccio, put some of the points at issue by saying in his report " Let us start from a series of now well-known facts: the progressive exhaustion, in almost all countries, of the hydro-electric resources which can still be economically harnessed; the generally lesser advantage of transporting electrical energy by comparison with the liquid or solid fuels with a sufficiently high energetic content, and consequently the installation of thermal power plants near consumption centres." Dr. Riccio, who is general-director of the Società Idrolettrica Piemonte, Turin, went on to argue: " Obviously all these factors entail a reduction of the energy transmission requirements; we must therefore wonder whether this reduction will be such as to compensate for the increase due to the natural development of the equipments or to give these requirements, in any case, an appreciably smaller increase." Other speakers dwelt on the possible increase in capital costs of transmission when very large loads had to be carried over very great distances, and said that in any case transmission advantages (except those connected with bringing in remote hydro-plants) were always marginal. If a small percentage were added to transmission costs, or interest on capital, the advantage of transmission would be nullified.

NETWORK ADVANTAGES

This Congress committee had therefore expressed caution, as far as the engineers involved in the " great interconnections " were concerned, in the planning of new lines. But on the same occasion an opposing stand had been taken by engineers whose experience was in countries which had not yet reached total internal extra high voltage interconnection. Spokesmen from the UK Central Electricity Generating Board had drawn attention to the general trend of European countries towards the realization of a complete 380/400 kV supergrid, able to integrate the electrical power resources of each country and capable at the same time of joining contiguous state networks. It was described how this type of approach was under development by the construction of power lines which could lend themselves to a two-stage expansion programme. Installations were thus being designed which would function in the first place at a lower voltage of perhaps 220 kV and which could subsequently be readily modified to carry 380/400 kV. The possibility of such conversion emerged as a primary proposition; the capital cost involved ranged from 1·5 per cent to 16·5 per cent lower for lines intended for the final voltage than for those constructed for later alteration from a smaller initial voltage. Now announced is a proposal by the CEGB for a 25-wire transmission system to carry 400 kV in north Wales—one of the first of its kind in Britain.

The institution of a system for exchanging power by submarine cable between Britain and France at 200 kV dc reinforced the contentions of those at Baden-Baden who championed the virtues of high voltage direct current generally. They felt that such a new dc potential offered solutions for other transmission problems involving considerable distances. It was submitted further that the continuous process of building more and more lines in parallel with each other would soon give rise to difficulties that could only be resolved by using direct current, where the power flow could always be limited to predetermined values. Herr Fleischer, of Deutsche Verbundgesellschaft, in particular expressed the view that the power transfer network controlled by countries belonging to UCPTE (Union pour la Coordination de la Production et du Transport de l'Electricité) would attain 55,000 MW covering 2,000 km in under ten years; he therefore concluded that the introduction of direct current could very well be unavoidable if the network was not to get out of hand.

RECIPROCAL STRENGTH

A study published by the Secretariat of the United Nations Economic Commission for Europe (ECE) in February, 1960, estimated that Europe's total electric power consumption (not including the USSR) had increased by 2·4 times in the decade since 1946. This report concluded: " Rapid exploitation of natural sources of electric power production has been the general rule. Outside the USSR only a few major concentrations of unused resources—including hydro-power in parts of Norway, Jugoslavia, Austria and Romania—remained to be brought into use by the end of the period. The generally continuing need for international exchange of electric power in helping to equate short-term changes in supply and demand, and the long-term substitution of electricity for other forms of energy nevertheless ensured that electric power transfers over an expanding European transmission system would retain an economic importance fully corresponding to the rapid growth of power consumption."

There are pointers here again to the two-sided situation which becomes increasingly apparent: the approaching end of major natural resources in the form of water power and the need (denied in part by some who now favour fuel transport or local generation) for greater interconnection, internally and externally. The ac grid extension is not without its drawbacks, and for correlating rise and fall in demand between adjoining countries with economic current exchanges, as well as for internal links over considerable distances, there is much to be said for the dc system.

Before examining what has been done to arrive at a comprehensive picture of European hydro-resources—that natural power which can perhaps most obviously of all be seen in its entirety of potential—it will be germane to glance at the situation which affects some of the characteristic countries of Europe individually, as far as the disposition of their domestic electric power is arranged. For comparative purposes, and for overall assessment, the data given in the Addendum to the second edition of *Organization of Electric Power Services in Europe* (United Nations, Geneva, 1961) prepared by the Secretariat of the Economic Commission for Europe throw light on these questions in the case of Belgium, Czechoslovakia, Denmark, Ireland, Luxembourg, Portugal and Spain, all information given having been supplied within the period February-April, 1961. Political as well as natural and technical considerations, of course, have a bearing on the kind of system operated.

POWER OF STATES

From this source it can be gathered that, in Belgium, the law recognizes the right of the State and of all individual provinces to set up all means of production to supply their own establishments. Private individuals and companies can also produce electric power to cover their own needs or with a view to distribution. There exist several provisions intended to permit the coordination of production and the utilization of recovered power. Privately-owned public distribution stations account for 53 per cent of total production, publically-owned stations for 3 per cent and industrial stations for 44 per cent. The net production in 1959 was $13{\cdot}179 \times 10^9$ kWh. Belgian power stations include four units of 115 MW and sixteen units of 50 to 60 MW. Capital investment programmes for the next few years provide for the entry into operation of several other units of 115 to 125 MW with re-superheating and with extremely high steam characteristics.

In contrast, all electric power stations and distribution undertakings in Czechoslovakia are owned by the whole nation. Electric power is produced partly by independent power stations responsible to the Ministry of Fuel and Power of the Czechoslovak Socialist Republic and partly by factory power stations related for purposes of organization to various branches of industry, and subject to the direction of the Ministry of Fuel and Power. There are 14 independent power production undertakings, comprising thermo- and hydro-electric power stations throughout the territory of the Republic. These power production undertakings supply power to one single State grid. There are ten power distribution installations spaced throughout the Republic. Total power from all stations for 1959 was 21,884 million kWh.

In Denmark, electricity is produced and distributed by municipal and private (cooperative and similar) companies, which must obey the " high tension act." These undertakings do not operate under a monopoly or concession system: they finance their investments through their own funds or the private credit system. Loans to municipal undertakings are approved by the Ministry of the Interior. The state does not control electricity prices. All electricity matters are dealt with by the Ministry of Public Works. Total production in the fiscal year 1959-60 was 4,932 ×

10^6 kWh, of which 0·6 per cent was hydro-electric power and 99·4 per cent thermal power-produced. The electricity production is concentrated in fourteen large power stations, which account for about 96 per cent of total production, these stations being owned by eleven companies. The five interconnected stations on Zealand are linked to the Swedish grid through three submarine 120 kV cables and some older 50 kV cables which are now held in reserve. The cables can transmit a maximum of about 300 MW. The eight stations on Jutland and Funen, another interconnected group, are being linked with West Germany through a 220 kV transmission line.

PEAT POTENTIAL

The generation, transmission, distribution and sale of electricity in Ireland have been nationalized since 1927, when the Electricity Supply Board was established by the Government to deal with all matters concerning electricity production and distribution. A similar board was set up to obtain peat from bogs, and almost all the peat thus procured is sold to the Electricity Supply Board for the generation of electricity. Total production of the supply board for the year ended 31 March, 1960, was $2{\cdot}094 \times 10^9$ kWh, of which 35·7 per cent was from hydro power and 64·3 per cent from thermal power. Total maximum generating capacity for the period was 688 MW. The total circuit length for transmission at 110 kV was 2,215 km.

Matters relating to electric power in Luxembourg are dealt with by the Ministry of Transport and Power, but matters which affect the construction of hydro-electric power stations fall within the jurisdiction of the government in council. The State Electricity Service, functioning under the authority of the Minister of Electric Power, is responsible for supplying electric power to the public sector. Electric power in the Grand Duchy is produced by steelworks using their blast-furnace gas to operate thermal power stations, by other self-producers usually supplying their own needs by, for instance, the use of petroleum products, and hydro-electric stations which are mainly state owned. The total production for 1960 was $1{,}465 \times 10^6$ kWh. Power is transmitted at 65 kV, and the length of the public supply transmission network is 120 km.

Under Portuguese law the production of power is mainly hydraulic, since thermal plant is used only as a reserve and support, consuming domestic fuels in the most appropriate quantities. Under this system the government may determine to close down thermal plants temporarily or finally, especially if they use imported fuels, when it might be possible to raise their power at no greater expense. Present laws and regulations allow any domestic unit which can show that it has the requisite technical and financial qualifications to acquire a concession for producing hydro-electric power. The State assists the setting-up of transmission lines and the necessary sub-stations. Small electric power stations are operated by the municipalities themselves or by holders of concessions from them. The government was authorized to create a National Load Distributing Board to control power production and coordinate the main producing and transmission units. This Board is composed of electric power producers operating public service plant or transport inter-connected with the National Electricity Systems with a total installed capacity of more than 10,000 kWh.

In Spain, the use of water resources for hydro-electric power is governed by the Water Resources Act of 13 June, 1879, and concessions to set up plant are granted by the Ministry of Public Works. Thermal and nuclear power sources are within the competence of the Ministry of Industry, as is also the distribution and sale of electric power. Undertakings producing, transmitting and distributing electric power are in the main private producers, private producers and distributors, semi-public producers (Instituto Nacional de Industrie), private suppliers and self-producers. The undertakings in the first group possess modern plants, set up in almost every case since 1939. For all undertakings, the total production in 1959 was $17{,}353 \times 10^6$ kWh, of which $14{,}256 \times 10^6$ kWh was of hydro origin and $3{,}097 \times 10^6$ kWh of thermal origin.

LIMIT OF WATERS

The general picture of hydro-electric resources has been outlined in *The Geographical Distribution of Gross Surface Hydro-Electric Potential in Europe*, a survey prepared this year by the Secretariat of the Economic Commission for Europe. It emerges that although hydro-electric resources account for nearly 40 per cent of Europe's electric energy production, no common basis of comparison has previously existed for studying the continent's hydro-electric potential comprehensively on an international scale.

A type of analysis involving the preparation of standardized seasonal flow data for a representative series of stream-flow records covering a common period of years and the working out of coefficients showing the amount of correlation between records situated in different regions has thrown useful light on the limits to inter-regional complementarity with respect to hydro-electric resources. When rank-order correlations of this kind are made between a centrally-located river basin, such as that of the Rhine at Bâle, and others situated at varying distances and in different directions, it is found, as might be expected, that the degree of correlation between the flow data, for summer and for winter half-years over a common 30 year period, is largely a function of distance. At the geographical extremes of the continent rank-order correlation coefficients are found to be commonly negligible, both for summer and winter periods, when comparison is made with central Europe. At medium distances moderate coefficients tend to occur while for basins separated by shorter distances the coefficients may be relatively high, except where some major mountain ranges intervene. Similar results appear to follow from comparisons between exactly comparable data for groups of river basins within some of the main regions of Europe. It is common to find certain differences between such coefficients for summer and winter half-years respectively, and in a number of cases (though not uniformly) the correspondence appears somewhat greater for summer periods.

SHARING NEW RESOURCES

This assessment of the water potential of Europe, in defining the limits of a major natural energy reserve, throws up more clearly the lengths to which other sources of power must be expanded to keep pace with the growth of electricity demands from the point of view of each country as a unit. As hydro-electric power drops out of the race, international current exchange may represent an opportune way of assisting those countries hitherto largely dependent on water, but who now find it inadequate and therefore cast around for other supplies.

With some developing countries, again, it may be more economic to import electricity for the long term rather than face an immediate programme of capital investment in other forms of generating power, thermal or even nuclear. On the other hand, such continental indications, for instance, as the water-power survey, will be of material help in gauging the necessary extent of other power generation methods generally and when and where best to initiate programmes for associated construction and transmission. At least it seems that neighbouring countries are already in a fair way to tiding one another over, as it were, when they run into electricity supply problems.

TABLE.—*Exchanges of Electric Energy between Adjacent Countries during* 1960 (10^6 kWh).

Importers' figures

Exporting country ↓ / Importing country →	Albania	Austria	Belgium	Bulgaria	Czechoslovakia	Denmark	Eastern Germany	Finland	France	Greece	Hungary	Ireland	Italy	Luxembourg	Netherlands	Norway	Poland	Portugal	Romania	Spain	Sweden	Switzerland	United Kingdom	USSR	Western Germany	Yugoslavia	Exports (total)
Albania	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Austria	—	—	—	—	141	—	—	—	—	—	—	—	49	—	—	—	—	—	—	—	—	95	—	—	2,523	25	2,833
Belgium	—	—	—	—	—	—	—	—	45	—	—	—	—	8	67	—	—	—	—	—	—	—	—	—	119	—	239
Bulgaria	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Czechoslovakia	—	66	—	—	—	—	—	—	—	—	443	—	—	—	—	—	209	—	—	—	—	—	—	—	—	—	
Denmark	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	224	—	—	—	71	—	295
Eastern Germany	—	—	—	—	71	—	—	—	—	—	—	—	—	—	—	—	420	—	—	—	—	—	—	—	7	—	498
Finland	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8	—	—	—	—	—	8
France	—	—	131	—	—	—	—	—	—	—	—	—	54	51	—	—	—	—	—	268*b*	—	600	—	—	349	—	1,453
Greece	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1
Hungary	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Ireland	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Italy	—	17	—	—	—	—	—	—	90	—	—	—	—	—	—	—	—	—	—	—	—	189	—	—	—	5	301
Luxembourg	—	—	36	—	—	—	—	—	10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	46
Netherlands	—	—	79	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	60	—	139
Norway	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	32	—	—	—	—	—	32
Poland	—	—	—	—	239	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Portugal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Romania	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Spain	—	—	—	—	—	—	—	—	375	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	376
Sweden	—	—	—	—	—	397	—	425	—	—	—	—	—	—	—	210	—	—	—	—	—	—	—	—	—	—	1,032
Switzerland	—	88	—	—	—	—	—	—	1,110	—	—	—	134	—	—	—	—	—	—	—	—	—	—	—	2,835	—	4,167
United Kingdom	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
USSR	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	30	—	—	—	—	—	—	—	—	—	30
Western Germany	—	486	128	—	—	—	—	—	30	—	—	—	—	—	88	—	—	—	—	—	—	404	—	—	—	—	1,136
Yugoslavia	—	22	—	—	—	—	—	—	—	—	94	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	116
Imports (total)*d*	—	679	374	—	451	397	—	425	1,715*a*	—	537	2	237	59	155	210	659	1	—	268*b*	264	1,307*c*	—	—	5,964	31	

a Including 55×10^6 kWh from Andorra. *b* Including 42×10^6 kWh from Andorra. *c* Including 19×10^6 kWh from Liechtenstein.
d Totals are shown only where the coverage of information from importers is complete.

From the *Annual Bulletin of Electric Energy Statistics for Europe, 1960*, United Nations, Geneva, 1961. NOTE—Since figures supplied by importing and exporting countries do not always agree, the export total—where it is included—may differ from figures received from exporters.

TURRET LATHES

Multiple-Disc Brake on Spindle

TYPES RE42 and RE55 turret lathes are developments of the Emag Type RE40 turret lathe. Both are manufactured to toolmaker's limits.

Among the features embodied are: single-lever operation of collet chuck, clutch, and brake; multiple-disc brake for stopping spindle; adjustable double-row precision roller bearings for spindle; and provision for mounting collets, chuck, or work-holding fixture on the spindle. The RE42 has a spindle bore of 1⅝ in and a capacity of 1⅝ in diameter using standard collets; respective capacities for the RE55 are 2⅛ in and 2⅛ in.

The turret normally indexes 60° but can also be skip-indexed for 120°. The cross slide has a hand wheel for facing. The cut-off slide, mounted overhead, is provided with an adjustable stop, the carrier is of large size. The lathe centre height is 7 in, total travel of turret slide 5½ in, diameter of six tool holes in turret 1 in, maximum distance collet to turret 11¾ in, maximum diameter of turret tools

4½ in. All of these dimensions apply to both models. *Addison Tool Company Limited, Marshalsea Road, London SE1.*

EXCAVATOR

Many Other Possible Uses

THE JCB3 hydraulically-operated excavator may also be used asa bulldozer, loading shovel, fall shovel, square-hole machine, and site stripper.

The machine has an integral frame, possesses a low centre of gravity, has an offset kingpost to facilitate close-quarter trenching, and is equipped with hydraulic stabilizers which allow vertical excavations to be made on ground with a slope up to 10° from the horizontal. The ground clearance is 23 in. Loading operations are controlled by a single lever and digging operations by two levers. The frame is an integral one of welded construction. Power steering contributes to manoeuvrability. The kingpost is carried on a carriage casting bolted to guides running across the rear of the frame. The carriage, mounted on rollers, may be power traversed. Length of the traverse is 5 ft 8 in; with the kingpost fully offset excavation is possible at the side of a wall to a depth of 11 ft with a standard arm.

Used as an excavator, the machine

has a reach of 15 ft 7 in. The slewing and digging arc is 200°. Tear out force is 10,600 lb, overall height in the travelling position 10 ft 3 in, overall width 8 ft, overall length 23 ft. Loading height of the face shovel is 10 ft 9 in. As a front-end loader, the height fully raised is 12 ft 9 in, maximum dump height 9 ft 4 in, tear out force 8,900 lb, lifting capacity 4,600 lb, forward reach at maximum discharge height 2 ft 8 in, maximum forward reach 3 ft 6 in, angle of dump at full height 40°, and angle of crowd 20°. Power is supplied by a Fordson diesel engine, developing 57 bhp at 1,800 rpm. *J. C. Bamford (Excavators) Limited, Lakeside, Rocester, Staffs.*

BILLET SHEARS

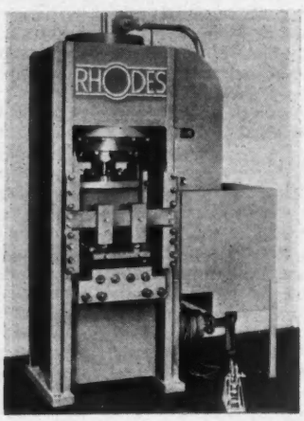
Electro-hydraulically Operated

PRIMARILY designed as a billet shear, the unit illustrated can be converted to work as a hydraulic double-sided press. The alteration is said to be made easily and at little or no extra cost.

Electro-pneumatic actuation is said to enable any work to be carried out with complete safety to the operator. Hydraulic pressure is derived from a motor-driven pump; ram movements are controlled by pneumatically-operated hydraulic valves. A pressure-relief valve in the hydraulic circuit is claimed to prevent overloading or any risk of damage to the machine.

Fabrication enables these shears to be constructed to meet individual requirements. It is said that the exceptionally long slideways ensure precise alignment of the ram and result in prolonged blade life.

The example illustrated has a stroke variable up to 5 in and will take mild or stainless steel having a 12 in × 1 in section. The pressure is 150 tons; stroking is single or continuous. The



maximum number of strokes per minute is 11. The blades have four cutting edges. Overall dimensions are: height 8 ft 3 in, depth from front to back 3 ft, width 5 ft 6 in. The weight is 5 tons. The shear is driven by a 20 hp motor. *Joseph Rhodes and Sons Limited, Grove Ironworks, Wakefield, Yorkshire.*

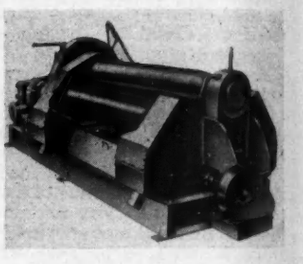
PLATE BENDING ROLLS

Easily Installed

DANISH-BUILT Scantic power-operated plate bending rolls are now available in Britain. The range extends to 80 different models. Three-roll pyramid machines are offered with capacities varying from 4 ft 2 in wide × $\frac{1}{16}$ in thick to 16 ft 8 in wide with a thickness of 1$\frac{3}{16}$ in. Four-roll initial pinch machines have capacities from 3 ft 3 in width and $\frac{1}{16}$ in thickness to 11 ft 7 in × $\frac{3}{4}$ in.

Claims made for these rolls are ease of operation, installation, and servicing. Correct working height can, it is said, be maintained by using the shop floor as a base, since no special foundations are stated to be required.

All models have bed frames fabricated from rolled steel channel sections. Bearing housings are of steel plate electrically welded throughout. The rolls, machined from steel forgings, run in phosphor-bronze bearings. In cases where stainless steel or soft alloy sheets are the materials to be worked, rolls with an extra fine finish can be supplied.



Driving gears are of steel. The three-roll machines can be supplied with hand or motorized adjustment to the top roll. The four-roll initial pinch machines have a fixed-position top roll and an adjustable bottom roll, operated by hand on the smaller models and by power on the larger. Roll adjustment drive employs phosphor-bronze wheels and steel worms on forged steel shafts running in ball and thrust bearings.

On the heavier models of both types, the drop end bearing is provided with power movement. Inclined setting for conical bending is possible on each type. *Soag Machine Tools Limited, Juxon Street London SE11.*

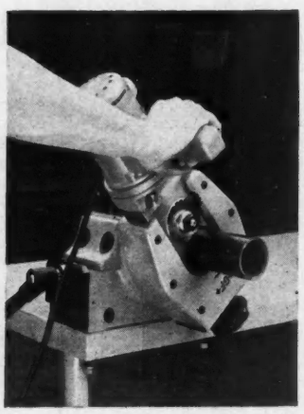
TUBE CUTTING MACHINE

Clean Finish

KNOWN as the +GF+ Model RA2, the power-operated tube cutting machine illustrated handles tube from ⅛ in to 2⅛ in OD, with wall thicknesses from $\frac{1}{16}$ in to ¼ in.

It is reported that all sizes of tubing within the machine's scope are cut within 10 sec, and that the cut is a clean square one, free from internal and external burrs. The circular saw, of 2¼ in diameter and running at 300 rpm, is said to be suitable for ferrous, non-ferrous, and plastic tubing. The tube to be cut is mounted in the integral self-centring vice which holds it concentric with the cutting head. The head is then rotated by the handle, one complete rotation only being required. The function of the control seen at the end of the rotating unit is to adjust the depth of the saw cut to enable tubes of varying thickness to be accommodated.

To facilitate repetition cutting a length gauge may be fitted. The machine is available with either a 210/250 V, 110 V, or 50 V single-phase 50 c/s per sec



660 W motor. Drive from the motor is transmitted to the saw through helical gears running in an oil bath. Control is by a trigger switch situated under the pistol-grip handle. The weight of the unit complete is 75 lb. *Le Bas Tube Company Limited, 129 Finsbury Pavement, London EC2.*

JAR-BAR GRIZZLY FEEDERS

Numerous Sizes

WITH capacities of up to 5,000 tons an hour, a new range of jar-bar grizzly feeders is now in production at Fraser and Chalmers' Engineering works.

Claimed to be the first of their type to be manufactured in this country, these feeders are said to be particularly suitable for the removal of clay or sticky fines from ore or stone before it is fed to a primary crushing plant. The machine illustrated is a 48 in 8 roll type, for heavy duty. Other machines in this category have 60 in or 72 in widths with capacities of up to 5,000 tons an hour. Standard-duty feeders are available in widths of 24, 30, 36, or 48 in, able to handle up to 2,000 tons an hour. Both heavy- and standard-duty machines are available with 8, 10, 12, or 14 rolls.

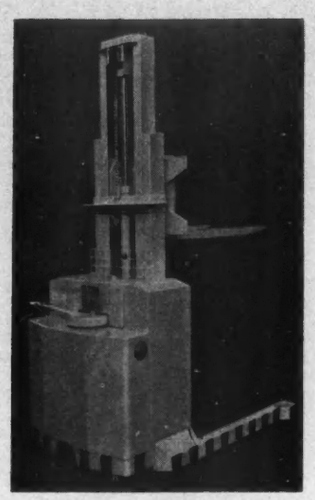
Employing elliptically-shaped rolls, arranged with the major axes of adjacent bars at right angles, forward feed can be obtained with the machine mounted horizontally or even inclined upwards. Skidding of the material over the rolls is said to be thus reduced to a minimum.

The fines load may be spread evenly over the conveyor belt. This is possible as the discharge setting can be varied for each pair of rolls. It is reported that a graduated discharge size of, say, from 1½ in to 10 in may be obtained from one machine.

When the machine is working, lumps of rock which are in contact with the rolls are alternately lifted and dropped, while at the same time being moved forward as the elliptical sections rise and turn over. The rocking motion, combined with a rubbing and sifting action, shakes the fines downwards and breaks up any large lumps of clay. *General Electric Company Limited, Erith, Kent.*

FORK-LIFT TRUCK

Available in Two Capacities



OFFERED in two forms, SS12/15 and SS15/20, with capacities of 1,120 and 1,500 lb at 24 in centres respectively, the Straddlestack fork-lift truck is battery operated.

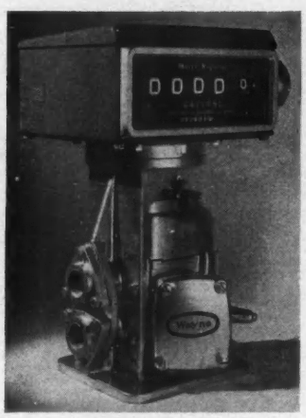
All controls are within easy reach of the driver, normally pedestrian, who may be accommodated on a platform if required. Steering is directed from the tiller arm, which also controls the band-type transmission brake. The turning radii of the two models is 45 in and 49 in. The ram-operated lift is controlled by a sensitive lever. A pre-set relief valve protects the hydraulic circuit; a flow-control valve at the base of the ram controls the downward movement of the load. All rams are chromium plated and the cylinder bores are honed. The two forward and two reverse speeds are selected by a lever on the tiller arm. Maximum speed is 4 mph.

Power is obtained from Kathanode traction batteries. On the SS12/15 model the battery gives a capacity of 132 Ah and on the SS15/20 model 198 Ah.

With the forks lowered the height is 75½ in and with them raised 129½ in. *Montgomerie Reid Engineering Company Limited, Bramley Green, Hants.*

LIQUID METER

Dispenses to Close Limits



KNOWN as the Micro-meter Model 2PM/3, this industrial liquid meter is based on the measuring unit incorporated in the Meteor petrol dispensing pump.

The meter, suitable for any liquid in the general petroleum and solvent range, is said to be capable of measuring out liquids to a standard of accuracy higher than that formerly associated with industrial meters, and is reported to be able to hold ± 0·125 per cent over an operating range from 120 to 1,200 gal per hr. Standard meters are supplied with a visible register recording in gallons or litres up to 9999·9 and with a 7-figure totaliser showing throughput to date. The visible register can be rotated through 360°. Meters can be supplied with ticket printing attachments.

Components are constructed from stainless steel and high duty non-corrosive aluminium alloy. An aluminium protective strainer, with a 120 mesh Monel metal screen, can be supplied. A calibrating device enables micro adjustment to be effected by a knob, one gradation of which represents a variation of 1 dr per gal; the total variation which can be effected is 4½ per cent. Maximum working pressure is 75 lb per sq. in, and maximum temperature 120° F. *Wayne Tank and Pump Company Limited, Western Road, Bracknell, Berks.*

AUTOMATIC FLUXING MACHINE

Simple Operation

THE Flowfluxer has been produced to speed up the fluxing of printed circuit panels; it is said to be suitable for any soldering production line.

It is claimed that the machine is simple to operate and gives perfect flux coverage. There is reported to be minimum evaporation of volatiles. Panels move over the unit in a straight line, simplifying the transfer mechanism and avoiding deviation in the production flow. Panels, after assembly, pass through a wave of flux which is said to be subject to fine height control and consistent in height. No flux is reported to find its way on to the top side of the panel.

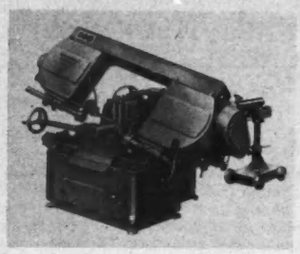
The flux is pumped by a stainless steel pump from the tank, which is covered to eliminate fire risk. The pump is driven by a ¼ hp motor and delivers approximately 12 gallons a minute at the nozzle aperture. A removable filter is fitted at the outlet from the tank and another filter is located in the nozzle. The mechanism is contained in a stove-enamelled cover which has a drip tray in the base to collect any accidental spillage.

With a capacity of two gallons, the unit measures 16 in height, is 9¾ in wide, and from front to back is 22¼ in. The maximum length of the flux wave is 10 in.

A larger version of the Fluxflower, capable of producing a flux wave 13 in long can be supplied. *Fry's Metal Foundries Limited, Tandem Works, Merton Abbey, London SW19.*

HORIZONTAL BANDSAW

Fully Automatic



SWISS-BUILT, the Habegger Type UMB-2VA-522 bandsaw has all functions controlled automatically and will produce any preset number of blanks. The capacity is 8 in.

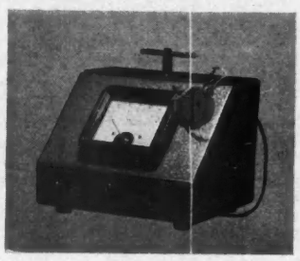
The cycle time between cuts is said to vary from 6 to 20 seconds and it is claimed that hand manipulation of heavy stock is entirely eliminated by the automatic feed system. The electro-hydraulic system is controlled by limit micro-switches and relay valves. Machine controls are placed on the saw beam, the electric subtracting-type counter is positioned on the cabinet base. The blade-tensioning mechanism includes a compensating spring; the saw frame hydraulic feed is adjusted from a calibrated hand regulator. An overhead roller is fitted to the front stationary vice to prevent stock rising during forward movement.

While sawing is in progress the stock is held in the front stationary vice and the sliding rear vice retracts a predetermined amount and then clamps the workpiece. On completion of the cut the saw frame rises and the rear vice moves the stock forward in sequence with the indexing cycle. The length of material to be cut off is set on a vernier scale to limits of 0·012 in; lengths up to 20 in can normally be cut but this dimension can be increased to meet special requirements. Micro-switches control the rear vice movement and no external end stop is used.

The blade is mounted on roller bearings, and has carbide-faced blocks for lateral control. Five cutting speeds are provided, ranging from 46 to 210 ft per min. *Startrite Machine Tool Company Limited, Darland Hall, Star Mill Lane, Chatham, Kent.*

WIRE FEED SPEED MONITOR

Photoelectric



CAPABLE of measuring accurately the rate at which wire is fed, as for example in consumable electrode welding, this monitoring instrument is also able to ascertain traversing or rotating table speeds in mechanized welding operations.

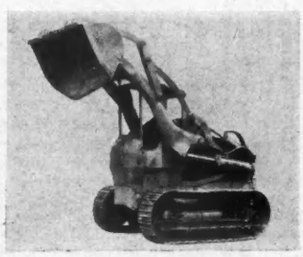
It is claimed that elimination of wire slip contributes to precise results. Independent of feed rolls, the instrument produces a signal capable of reproduction either on an oscilloscope or directly on a meter graduated in inches per minute. Calibrations when a meter is used are 0 to 30, 0 to 300, and 0 to 600 in/min; the entire scale is used in each range, which is selected by means of a switch.

The wire itself drives a milled spindle, to the end of which is fixed a disc having regularly-spaced slots around its periphery. This disc, located between a small lamp and a photoelectric cell, interrupts the light beam as it rotates and the electrical resistance of the cell alternates accordingly. The cycles take place 72 times each time the driving spindle rotates. The change in electrical resistance, applied to a transistorized amplifying circuit produces a square wave output signal which, fed into an electronic frequency meter gives the meter reading.

Due to the necessity of the value of the light energizing the photo cell remaining constant, a position is provided on the selection switch for measuring the output of the 6V lamp battery. The instrument illustrated is a prototype; it is understood that no arrangements have yet been made for its manufacture. *British Welding Research Association, Abington Hall, Cambridge.*

FRONT END LOADER

Flexible Operation



WITH a bucket capacity of 1¾ cu. yd, the Model 123 crawler-based front end loader is able to dump at heights up to 115 in and has a dump reach of 44 in.

Reported to exert a maximum breakout force of 25,000 lb, and to be able to operate on 1 in 1 slopes, forward or backward with a full bucket load, the loader is said to complete a cycle of lifting tipping, and lowering in less than 15 seconds. A feature of the machine is the main frame, formed from a single steel casting; smaller castings are used for the track frames and bucket arms. Hydraulic power for the four rams is supplied from a pump immersed in a pressurized reservoir, the purpose of this arrangement being to exclude dirt. Drive is through a torque converter; there are four speeds in each direction; all gears are constantly in mesh and rotate in one direction; change of speed and direction is effected by hydraulically actuated metallic oil cooled clutches.. The dual final drives can be operated independently, enabling the all steel tracks to be run in opposite directions when the loader will turn on a radius of less than 7 ft. Ground clearance is 17 in.

Power is provided by a four cylinder 100 hp diesel engine. Twin suction fans, drawing air away from the engine and a self cleaning dry air filter are said to improve cooling and reduce abrasion of the radiator core by grit and dirt. Sealed disc brakes are located within the frames.

The track and carrier rollers are one piece alloy steel castings, running on sealed taper roller bearings. Track adjustment is hydraulically effected. *Eimco (Great Britain) Limited, Earlsway, Team Valley, Gateshead 11, Co. Durham.*

WALL THICKNESS GAUGE

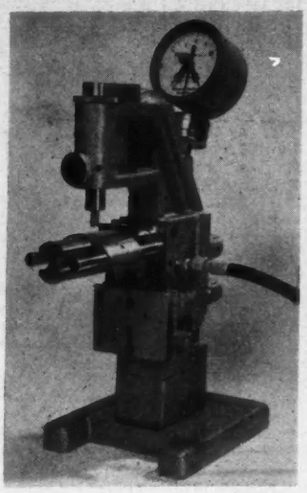
Adjustable

AN ADDITION to the maker's range of air gauges, this is designed to measure the wall thickness of plain bearings, cylindrical bushes, and similar parts.

Setting up is claimed to be particularly easy. Built into the unit is a pneumatic span-setting master, against which pneumatic calibration can be readily checked. A nominal size master is then used to enable the adjustable upper nozzle to be positioned correctly for the particular size of work piece. The nominal master may be anything of accurately known size.

Components from 1½ to 7½ in internal diameter, with a wall thickness up to ⅛ in, may be measured. The gauge will also measure concentricity of the bore relative to the outside diameter, by ascertaining variation in wall thickness. The tungsten-carbide wear surfaces are surface finished to approximately 1μ in.

The gauge is available with two measuring ranges; ± 0·001 in, reading to 0·0001 in (magnification 1,800) and ± 0·002 in, reading to 0·0002 in (magnification 900). An air supply of between



60 and 150 lb per sq. in is required. *Teddington Industrial Equipment Limited, Windmill Road, Sunbury-on-Thames, Middlesex.*

AUTOCOLLIMATOR

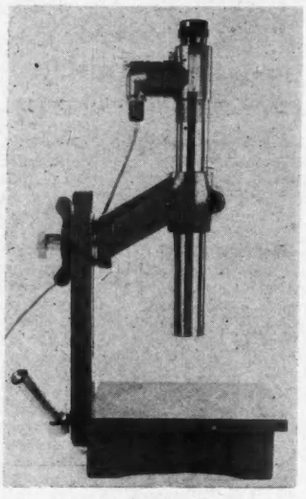
Micrometer Eyepiece

REDESIGNED to embody a number of new features, the TA121 micrometer angle Dekkor autocollimator measures displacement in two planes at 90° to each other, depending upon the mounting position.

The new eyepiece is reported to make observation easy and the long eyepoint is said to be especially useful to wearers of spectacles. There is a ground one-piece telescope tube for quick mounting. Intensity of illumination is controllable to suit working conditions. There is direct reading to 0·5″. An external micrometer-turns counter is provided.

In addition to general workshop applications, the instrument is claimed to be suitable for precision testing of flatness, straightness, and squareness. The measuring range is 20′ of arc and the recommended maximum working distance is 80 ft.

The micrometer drum is graduated at 0·5″ intervals, figured every 5 seconds; one revolution of the drum represents



1′ of arc. The weight of the unit is 5 lb. *Hilger and Watts Limited, 98 St Pancras Way, London, NW1.*

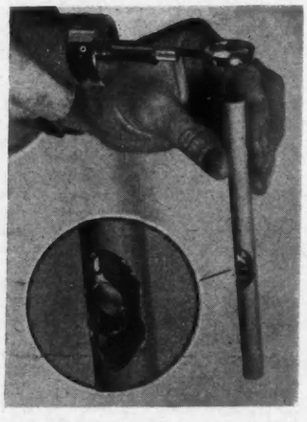
BORE VIEWER

Suitable for Small Holes

THE bore viewer illustrated is suitable for the wall examination of small-diameter holes.

Inspection is possible of the inside of holes from $\frac{1}{16}$ in diameter up to approximately 1¼ in. Lengths covered are up to 8 in. In addition to the examination of straightforward holes and bores, it is suggested that the device lends itself to inspecting the valves and cylinders of hydraulic and pneumatic control equipment, burner parts including valves, meters, and nozzles, bearings of all kinds, wave guides and other electronic components, and precision pipe fittings.

Consisting of three parts, the battery handle, the light probe, and the sleeve with an elliptical mirror, the viewer is available in two sizes each of three lengths. The Series 316 is recommended for holes of from $\frac{1}{16}$ in to $\frac{1}{16}$ in diameter. The mirror of this model is $\frac{11}{64}$ in wide and is mounted on a probe of 0·08 in diameter. The Series 380 viewer is for holes of from $\frac{1}{16}$ in to 1¼ in diameter, the mirror is ⅛ in wide and is carried on a



probe, the diameter of which is 0·109 in.

The side walls of the bore are illuminated by a small lamp and viewed in the mirror through a magnifying lens. For the 2 in long models the magnification is × 4 and for the 6 and 8 in sizes × 2. *P. W. Allen and Company, 253 Liverpool Road, London N1.*

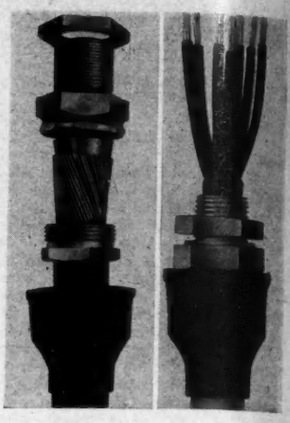
CABLE GLAND

Suitable for Many Sizes

DEVELOPED for use with pvc insulated cables, this cable gland is claimed to be suitable for all SWA cables.

Said to be adjustable to a wide range of requirements, the gland is also reported to ensure full thread engagement between the gland components at all times, irrespective of any changes in the diameter of the armouring wire. Fitting is described as quickly and easily accomplished. Each size will centre in two sizes of knock-out hole. This enables seven sizes of gland to cover cable sizes from 3 × 029 (0·002 sq. in) up to 61 × 103 (0·5 sq. in), in a range of voltages from 250 to 3,300.

The right-hand illustration shows the gland, with a protective shroud, fitted to a multi-core cable. The exploded view illustrates the assembly of the various components on the cable end. The gland is manufactured from 30/40 ton manganese-bronze, finished in tin-nickel plate. The shroud, which is supplied when required, is made from material stated to withstand water, oil, spirit,



high ozone densities, and corona effects.

Glands are suitable for 250-440, 660-1,100 and 1,900-3,300V. Gland sizes are intended to comply with dimensions given in BSS 3346:1961. Permanent earth continuity is said to be ensured. *Cable Covers Limited, St. Stephen's House, Westminster, London, SW1.*

LATEX DIPPING MACHINE

Compact Layout

THE machine illustrated is a new version of the Cotswold Mark V11R controlled-extraction latex dipping machine.

Modifications embodied are stated to result in a complete yet compact unit. Depth of immersion is reported to be precisely controlled and pre-set. It is said that the secondary control valves are so sensitive that component extraction rates down to as little as $\frac{1}{16}$ in per minute are obtainable, with consistent withdrawal.

A stainless-steel circulating tank is provided, in addition to a coagulant tank of the same material. A trolley, with capacity for a batch of formers 2 ft 3 in by 1 ft 6 in runs on rails over either tank, enabling successive dips to be made as required. The inner frame of the trolley is rotatable and invertable; roller guides are fitted into which former bars can be fitted in batches or individually.

Immersion and extraction are performed by ram fed from a totally

immersed hydraulic pump. Speed of the ram is controlled by a rotary selector valve and two metering valves. The latter are set to control speeds of immersion and extraction, the former brings each into circuit as required. *Lionel Hook and Sons Limited, Stroud, Gloucestershire.*

FLASH WELDER

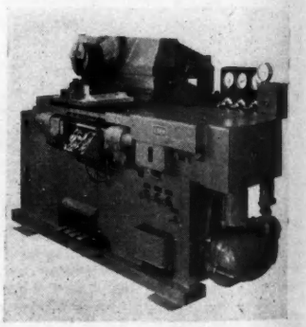
High-Speed Clamping Arrangements

THE BAJ32/120 flash wleding machine incorporates Alligator clamping.

Clamping equipment is operated by a pneumatic-hydraulic system, reported to give high-speed jaw closure. Thereafter pressure is built up until it is claimed, a maximum clamping force of 24 tons is attained. Both the table and the swivelling upper jaws are cast in high-tensile steel; the fabricated mild steel main frame provides general support for the equipment and resists longitudinal forging loads of up to 12 tons. The arm contour is said to render the machine particularly suitable for use on cylindrical components.

The greatest cross section which the machine will weld is 2·33 sq. in. Maximum width of strip which can be received between the arms is 11¾ in. Cylindrical components manufactured from strip of this width can be welded down to diameters of 13¾ in. At widths less than 4¾ in it is possible to weld diameters down to 9¾ in.

Closure of the clamps is performed



by a primary ram; a secondary ram then imparts clamping and forging pressures, the latter can be applied at any desired point. Automatic welding sequence is initiated by a pushbutton control fitted to the front of the machine; a sequence control unit and an ignitron or magnetic contactor are housed in a separate cabinet. Manual control is also provided. *Electro Mechan-Heat Limited, Manor Works, Ettingshall, Wolverhampton, Staffordshire.*

Companies

Encouraging Get-together by British and Indians

ARRANGEMENTS have now been finalized for the setting up of a £127,000 Permali factory in India for the manufacture of a full range of densified wood laminates.

A fresh company is being formed to operate the new venture and will be known as PERMALI-WALLACE LIMITED, with headquarters at Bhopal, some 400 miles south of Delhi. This firm is the outcome of collaboration between PERMALI LIMITED, Gloucester, and CHAS. LOWE AND COMPANY LIMITED, Manchester, with the INDIAN PLYWOOD MANUFACTURING COMPANY LIMITED and the WALLACE FLOUR MILLS COMPANY LIMITED, Bombay.

Permawood, Permali, Hydulignum and Jabroc are the specialized wood laminates which are to be manufactured. A considerable outlet from the new works for these products is confidently expected, as they have the varying degrees of impregnation and density necessary for such applications as electrical insulation, rail-track insulation, textile-machinery parts and neutron shielding; to mention a few of their uses. An initial annual turnover of some £250,000 is anticipated.

British Training for Key Personnel

Full manufacturing facilities are being incorporated. These will include a press shop, a machine shop and finishing departments. A special feature will be the provision of equipment for controlling the factory's humidity level in the processing areas, in order to overcome the extremes of the Indian climate. The special-purpose processing plant and most of the machine tools required are being dispatched from Britain.

Construction is scheduled to commence this month and the whole installation is expected to be completed by the late summer next year. Indian sources will be used almost entirely for the raw materials; the special resins required will be manufactured on the premises by Permali-Wallace, and combined with suitable indigenous Indian timbers.

The directors will be partly British and partly Indian, but the factory will be staffed entirely by Indians. Certain of the key personnel will receive special preliminary training in this country.

Mr. A. A. Heath and Mr. R. W. Lowe are to be the present British directors and Mr. N. V. Kanji, Mr. K. S. Lauly and Mr. C. K. Vissanji, the Indian directors. Mr. J. V. Kanji, also an Indian, will be chairman of the firm's board of directors. Mr. R. Ely, of Permali Limited, Gloucester, has been appointed resident engineer and liaison officer in India.

Exports by Permali-Wallace are expected to play a useful part in benefiting the existing Indian foreign exchange position.

The parent British firm collaborating in the new venture, Permali Limited, have their head office and works at Bristol Road, Gloucester. An extensive reputation has been gained by the wide range of insulating materials which they produce. These are marketed under such trade names as Permali, Permaglass, Dialam and Permaflon.

British Water Turbines Made in India

A British company, GILBERT GILKES AND GORDON LIMITED, Kendal, Westmorland, have concluded an agreement with JYOTI LIMITED, pump and water turbine manufacturers, of Baroda, India, whereby the latter firm will receive technical assistance in the production of water turbines, governors, and other machines, to certain of Gilkes's designs.

Considerable benefit is expected to be derived by both firms of hydraulic engineers from the new arrangement. Jyoti already manufacture a range of standard adjustable blade propeller and small Francis and cross-flow turbines, which have been primarily designed as standard units for use on canal falls. The units have also been employed in connection with the lighting of villages in some of the more mountainous parts of India.

Designs of the Gilkes company will be employed more particularly where larger units are required and for higher head installations where turbo impulse and pelton wheels are needed.

Jyoti Limited are also to act as distributors for such types of Gilkes's turbines as cannot be manufactured economically in India.

Public Relations International

From their headquarters at Peterborough, the PERKINS group of companies are establishing an international public relations organization.

This action has been taken as part of the group's world-wide operations, which now include the manufacture of outboard motors and gas turbines, in addition to their construction of around a thousand diesel engines a day at their United Kingdom plant alone.

The new public relations division, which will be headed by Mr. John Bowman, will assist in establishing the Perkins world power standardization concept, an advanced marketing theme which is already making a major contribution to the firm's international attainments.

Put simply, the scheme means that parts, know-how, service and, in many cases, actual manufacturing facilities for the construction of identical high-quality power units of any type of Perkins's products are becoming progressively available anywhere in the world.

In future, Mr. Bowman will be known as general public relations manager to the Perkins group and will be responsible directly to Mr. M. I. Prichard, the group's managing director.

Ball Bearings in Wide Variety

Rapid advances in technical development during the last few years have led to demands for ball bearings made of many unusual materials and of greatly increased precision. Balls, with diameters of from a few thousandths of an inch to 11 in, are now readily obtainable.

A firm which specializes in the distribution of precision ball bearings, as well as of other types of bearings and of machine tool accessories generally, is Insley Industrial Supply Company Limited. They can supply balls constructed from some 30 different materials, including stainless-steel alloys, synthetic sapphires, ceramics, high-speed steels, non-ferrous alloys, carbides and a variety of plastics.

The continued increase of this firm's activities has necessitated a move to larger premises at Insley House, 5 Windmill Street, London W1 (Telephone: LANgham 5426). The name of the firm has been abbreviated to INSLEY INDUSTRIAL LIMITED.

German Branch for Electronic Associates

A wholly-owned subsidiary company has been formed at Aachen in West Germany by ELECTRONIC ASSOCIATES INCORPORATED for the handling of their instrument sales in that country.

The new concern, Electronic Associates Incorporated GmbH, will operate in support of the parent company's existing sales arrangements for western Continental Europe, which are based on Brussels. Included among the range of instruments which EAI GmbH will handle are the TR-10 transistorized desk-top-size general-purpose analogue computer, small plotting boards, and other instruments used in analogue computing processes.

The EAI president, Mr. Lloyd F. Christianson, considers that his organization should sell more than a million pounds worth of analogue computers and related data-processing equipment and instruments to Europe during the current year.

Powell Duffryn Exhibits

Among the exhibitors at the forthcoming International Factory Equipment Exhibition, which is being held at Earls Court, London SW5, from 13 to 18 of this month, are the POWELL DUFFRYN ENGINEERING COMPANY LIMITED, London EC3.

In addition to their stand in the static section, the company are exhibiting three of their Dempster series of vehicles in the exhibition's outdoor demonstration area. One of these, the LFW.253C Dempster Dumpster vehicle is able to pick up, transport and dump containers having a capacity of from 2½ to 15 cu. yd and to deal with loads weighing up to 38,000 lb net. The accompanying illustration shows the vehicle dealing with a varied assortment of rubbish.

Their DB24 Dempster Dumpmaster compaction collector and container servicing unit, another exhibit, automatically picks up and empties into its own body, which has a capacity of 24 cu. yd, containers of from 1 to 6 cu. yd capacity and of up to 3,000 lb in weight. A 25 ton compaction ram, part of this servicing unit, provides a 2 : 1 compaction.

The third exhibit, a 22,000T Dempster Dinosaur loader/transporter, picks up, transports, and tips or sets down on the ground, preloaded bodies having a capacity of up to 40 cu. yd.

Powell Duffryn Engineering Company's Dempster Dumpster servicing system can tackle loads of up to 38,000 lb net. Here, the vehicle is shown dealing gracefully with a quantity of assorted rubbish.

A New Post Created by Vickers

Mr. T. S. J. Anderson, C.B.E., M.A., who has been director of studies at the Royal Military Academy, Sandhurst, since July, 1948, and who was previously external registrar at the University of London, is to join the staff of VICKERS LIMITED, London SW1, on 1 January.

He will be the first occupant of the newly-created appointment of controller of education and training. This position will carry with it the status of a principal officer of the firm.

Mr. B. Baxter, M.Sc., who is at present the chief representative of Bureau Veritas in the United Kingdom, is to join YARROW AND COMPANY LIMITED, Scotstoun, Glasgow, in January next. He will become the firm's principal naval architect and shipbuilding director of the company in July, 1962, on the retirement of Mr. A. R. Mitchell, M.B.E., at that time. Mr. Baxter is a member of council of the Royal Institution of Naval Architects.

SHORT BROTHERS AND HARLAND LIMITED, Belfast, have appointed Mr. H. G. Conway and Mr. R. E. Harvey as joint managing directors. They have been joint deputy managing directors to the company since October, 1957.

Oil Company Uses Zinc Silicate Coating

Esso now have several years' experience in protecting old oil tankers internally with a zinc silicate formulation. Its use has now been extended to a tanker under construction.

INORGANIC coatings of the zinc silicate type have been successfully used to protect steel in certain environments for about 25 years. There are now several on the market both in the UK and in America, and one of them under the trade name of Rustban 190 has reached a particularly interesting stage in its career. This product is made by Humble Oil in America and is imported into the UK by Esso Petroleum Company.

Esso have now applied Rustban 190 to over a million sq. ft of steel surface, and there is strong feeling in the marine department of this company that it should be used on all internal surfaces of four 47,000 tons deadweight (dwt) tankers now being constructed. The decision to use Rustban has in fact already been made for two of the tankers, a project which is described in more detail later.

Esso are just carrying out a cost analysis of having applied Rustban 190 to the internal surfaces of eight tankers during the last two years, totalling 976,000 sq. ft of steel. They can then decide whether to adopt the coating as an alternative to no protection, cathodic protection, or epoxy coatings, to tank interiors, separate decisions having to be made with regard to the repair of existing tankers and to coating of new tonnage. This arises because the cost of surface preparation of waxed and pitted tanks is estimated to be nearly twice the cost of preparing new steel: so with the long expectation of life afforded by Rustban, a decision has to be made whether to line an old tanker at high cost in expectation of a service life which will extend beyond that of the propulsion and auxiliary machinery.

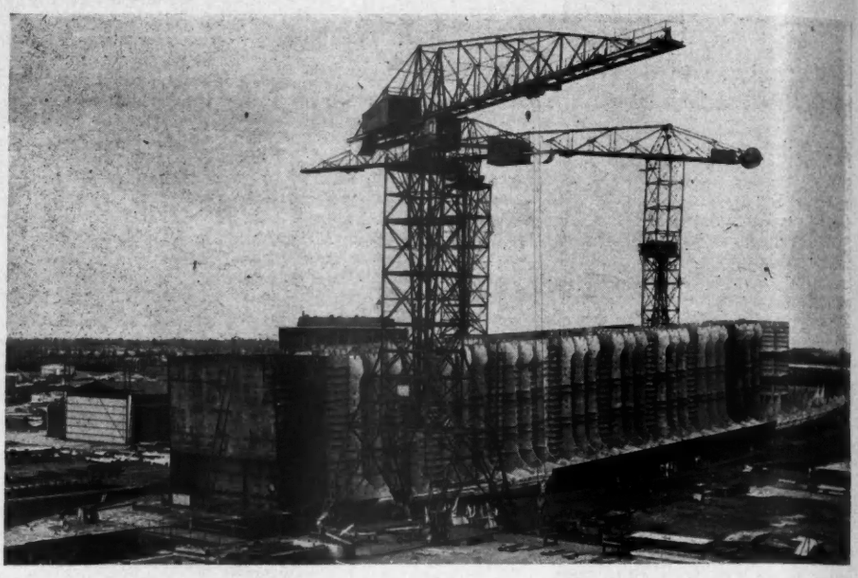
It appears that the expectation of life of these coatings is about 14 years, based on accelerated tests carried out in the USA by Esso Research and Engineering in which protected and unprotected steel sheets underwent a regular immersion cycle in petroleum products, salt water, hot salt water and salty air. Allowing a 10 to 15 year life (before corrosion structurally weakens the the tanks) beyond the first failure of the Rustban 190, it is therefore possible to foresee internal tanks outliving even a new vessel on an accepted service life of 20 years.

These figures refer to accelerated tests and will be discounted by many. But linings on tankers themselves support the estimates. For instance, the Esso Canterbury, a 26,000 ton dwt crude oil tanker, had six wing tanks coated with Rustban when it was in dock in late 1959. The internal surfaces were then in what Esso describe as a "pretty rusty condition" after five years' service, so that extensive structural renewals would have been needed by its 16th year.

When surveyed in August and September 1961 after two years of handling mainly acidic crudes, Esso found that there was no rusting, undercutting or creep of rust, and that even in a small area of overlaps where there was minor failure, no touching-up was needed. They now know even how to avoid what minor failure occurred there.

In America, Humble Oil and Esso are reported to have had satisfactory experience with Rustban 190 extending over five years. Also, similar compositions have been performing successfully for over 20 years.

Esso's experience with Rustban 190 is now such that they would strongly recommend its use for a single-coat protection to bridges, especially prefabricated ones; to steel structures immersed in salt water used as an undercoat; and to many exposed industrial structures where sprayed zinc would be considered.



47,000 ton dwt tanker under construction at Amsterdam. Note the sections coated with Rustban (pale grey).

Rustban is an inorganic coating whose optimum dry film thickness is about 0·002 to 0·004 in. This is obtained by applying a single coat and either curing this by heat or by subsequently spraying with a curing solution. The first solution contains a high percentage of zinc and will cover between 175 and 280 sq. ft per gallon. The total material cost of the final cured coating at the higher coverage is about 9*d* per sq. ft, say Esso. As is required for the satisfactory application of zinc or epoxies, the surface needs to be cleaned and sand or grit blasted to a white finish.

Although an inorganic coating, Rustban 190 in the cured state is not soluble in water and the tests by Esso referred to previously indicate that it also has good resistance to salt water. There are many inorganic acids and strong alkalies which will attack the zinc in the coating, at least according to statements by Humble. But according to the same source, it is immune from attack by nearly every petroleum or organic material, and in practical tests in a 26,000 ton dwt vessel carrying heavily acidic crudes it has been shown by Esso that, for this cargo at least, the claims are conservative in that no damage was observed after four sorties when damage had been predicted.

Sand blasting prefabricated sections in shed erected in Amsterdam specially for the coating project.

The present construction of two tankers of 47,000 tons dwt in Holland by NDSM of Amsterdam afforded the first opportunity which Esso had of applying Rustban 190 to a new construction on an ocean-going vessel. Two further vessels of the same tonnage being built by Vickers-Armstrongs at Walker-on-Tyne, may also be coated with this material.

For this project, NDSM constructed a special shed which is illustrated here. Coupled up with techniques of substantial prefabrication, this is permitting sand blasting and application of Rustban 190 in the most economic manner. A drawback could be anticipated in subsequent difficulties in welding and making good the coating after welds and mechanical damage to the coating. But the one feature which particularly endears this material to Esso is its great resistance to abrasion and mechanical damage (which is such that they have used the material extensively as a primer for tanker topsides and boot-topping subjected to damage). Thus, in the Dutch shipyard, Esso report that no wear has been noticed on coated parts even on gangways.

In preparation, strips are covered with adhesive tape where welding will be carried out so that no zinc oxide is evolved during welding. Resulting from the resistance of Rustban 190 to cherry-red temperatures, Esso have not been able to detect any harm to the coating after welding on the reverse side of 1 in steel ships plate, and this will probably prove to be true also for thinner sections. Completed welds are cleaned with Vacublast portable equipment and the surfaces made good with Rustban 190 by hand or spray.

Esso gather that the erection of this pretreatment shed by NDSM has put them in a favourable position with regard to further orders for fully coated ships, and enquiries for some have already been received.

Commercially, this coating is obtainable through F. A. Hughes and Company in London under the same name of Rustban 190. Esso comment that engineering contractors should be able to undertake application after learning know-how from F. A. Hughes, and that this company offer an inspection service (to be used subject to agreement between all parties involved) to ensure that the coating has been applied to best advantage.

Esso Petroleum Company Limited, Marine Department, Thames House, Millbank, London SW1.

Plastic-Coated Steel on Vending Machine

Automatic fuel vending machines for use in various parts of north-west England are being made with a plastic-coated steel exterior. The makers of the vending machines are Austin Hopkinson and Company and their machine is called the Pikrose Fuel-O-Matic.

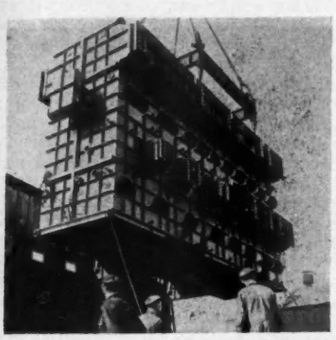
John Summers, makers of the Stelvetite plastic-coated steel, say that Austin Hopkinson first tried aluminium for the cladding but that they found that penknives could damage it.

Austin Hopkinson and Company Limited, Audenshaw, Lancashire.

Water Distiller for "Northern Star"

Distillation of fresh water from the sea has long been standard practice aboard oceangoing vessels, comment G. and J. Weir, makers of distillation equipment; many of these plants are of the vacuum-flash type in which the heated sea water flashes off a portion as vapour as it enters a chamber under sub-atmospheric pressure.

G. and J. Weir have now developed a marine version of their Multiflash system, and the first of these plants has recently been installed in the new Shaw Savill liner Northern Star. The makers comment that the Multiflash system has been adopted successfully for large and small



land installations at Kuwait, Guernsey, and Luderitz in South West Africa.

Designed at the Cathcart headquarters of G. and J. Weir, and prefabricated in sections at the yard of Charles Connell and Company of Glasgow, the plant was transported by road to the quayside at Vickers-Armstrongs (Shipbuilders), Walker-on-Tyne, where assembly was completed before installation in the vessel.

The Weir unit, which employs 20 flash chambers, weighs 100 tons. It measures 32 ft long by 12 ft wide by 17 ft high and is claimed to produce 500 tons of fresh water per 24 hours. This output is almost exactly the same as for the land plant now under construction at Luderitz.

G. and J. Weir Limited, Cathcart, Glasgow S4.

Fatigue Test on Threaded Anchorage

A successful fatigue test has been run at Lehigh University, Pennsylvania, on a 1⅛ in Macalloy bar with rolled thread anchorages, according to a report from McCall and Company (Sheffield).

The test bar, supplied from Sheffield, was from a normal cast of steel and had rolled threads each end. A stress range of 85,000 to 100,000 lb per sq. in was applied through the rolled thread anchorages to the bar for 3 million cycles without failure. This compares with the recommended prestressing force after losses of 88,000 lb per sq. in.

When taken out of the fatigue testing machine and tested to destruction, the assembly gave a strength of 143,000 lb. The specified ultimate stress for Macalloy steel is 143,000 to 161,000 lb per sq. in. McCall and Company comment that this test once more proves the suitability of rolled threads for anchoring prestressing bars.

McCall and Company (Sheffield) Limited, Templeborough, Sheffield.

Perforated Metal With Small Holes

N. Greening and Sons announce their introduction of a range of perforated metal called Perflec. This is made by electroforming and hole sizes range from 0·027 to 0·003 in with specials going down as low as 0·001 in hole size.

Perflec is claimed to be the only material of its type made in the UK. It consists of a pure copper core heavily clad with pure nickel. Normal thicknesses (depending on mesh count) are between 0·010 and 0·003 in. The material is said to be flat, smooth, tough and capable of being easily cut, punched, bent or formed. It cannot fray and edge binding is normally unnecessary.

The makers comment that the rigid integral construction gives freedom from aperture distortion under stress and permits formed cylinders to be used unsupported. By virtue of its nickel-clad copper construction Perflec can be hard or soft soldered and spot or seam welded.

The electroforming process results in holes with a slight taper and Greening comment that this has afforded exceptional results where filters are back washed for cleaning. Standard Perflec is produced in rolls 3 ft wide and up to 100 ft long. It is available in five counts producing 15 aperture sizes and thicknesses.

N. Greening and Sons Limited, Britannia Works, Warrington, Lancashire.

Aluminium Propeller 18 ft Diameter

What Alcan Industries claim to be the biggest die-forged aluminium propeller blade yet made in Britain was recently produced for the de Havilland Aircraft Company, who are supplying the propeller equipment for three prototype Transall C160 aircraft ordered for the French and German Air Forces.

Powered by two Rolls-Royce Tyne turbine engines, the Transall C160 is a tactical transport designed to operate from short air strips in forward battle areas. It is being built by a consortium of French and German companies including SNCAN (Nord Aviation), Weserflugzeugbau, Hamburgerflugzeugbau, and Buro-Blum. The first flight is scheduled for the autumn of 1962.

The de Havilland 4/8000/6 type propeller, with a diameter of 18 ft—four feet greater than the height of a double-decker bus—was specially designed for the Transall C160, and is the result of six years' intensive design and development work on the Tyne turbine engine, report Alcan Industries.

The propeller hub, which incorporates the familiar features of Hydromatic design, also embodies a number of improvements necessitated by the characteristics of the Tyne turbine engine. The basic unit upon which the propeller is built is the spider, a high tensile steel forging accurately machined to fit the engine propeller shaft. The four aluminium alloy blades are retained on the arms of the spider by a high tensile steel barrel of two piece design, upon which the pitch-change mechanism is mounted.

The solid aluminium alloy propeller blades, of double-taper plan form, are machined from forgings produced at the Handsworth (Birmingham) Works of Alcan Industries on their 45,000 lb forging hammer.

The blades are made from extruded forging stock in Noral 17S alloy. As manufactured, the forging stock is cylindrical in form, 87 in long, 8½ in in diameter, and 500 lb in weight. Prior to forging, the stock is scalped to a diameter of 7½ in and one end is machined to provide a 7 in long tong hold. The stock is then soaked in a preheat furnace, and having been brought up to a temperature of 450° C, at which point it is malleable, it receives the first of three part-stampings in the preparation dies of the forging hammer, alternated with intermediate preheats.

The partly forged blade is closely inspected between each operation and the excess metal, or flash, is removed. This preheat/part-stamp sequence continues with the finishing dies, after which the tong hold is removed and the hub machined. At this point, the blade measures

108 in in length with a maximum width of 19½ in.

After a further soaking in the preheat furnace, the blade is placed in an upsetting press where the steel thrust rungs are retained on the shank by an upset flange. The upsetting operation, which reduces the length of the blade to 105 in, is followed by solution heat treatment (the metal ageing naturally at room temperature and reaching its maximum properties after about five days), truing of the blade and ensuring a twist of 48½°, and finally polishing of the thrust rings. The weight of the blade on leaving the forge is 350 lb.

At the de Havilland Company's works at Stevenage, the blades are machined to a maximum width of 18·4 in after which they are anodized.

Alcan Industries Limited, Banbury, Oxon.

Instrument Production Fit for Research

Scientific and technical advances demand complex but accurate measurement and indicating instruments. Manufacture of sensitive equipment necessitates setting up production facilities in conditions fit for research.

MORE than ever before, man must measure. From industry, from medicine, and from scientific and educational establishments there is a mounting demand for increasingly accurate and increasingly sophisticated measurement and indicating equipment. One of the companies helping to meet this demand is the Cambridge Instrument Company, and an important addition to their production resources is the 15,000 sq. ft assembly wing officially opened last week at their Cambridge factory.

This enlargement of production capacity has become essential to keep pace with the new concepts of instrumentation opened up by their research department and with the new markets opened by their virile sales organization. The company has a tradition of *avant garde* research dating back to 1881 when it was founded by Sir Horace Darwin, the son of the famous Sir Charles Darwin, F.R.S. In those days, a staff of seven, working in a small workshop on the site of the present research department and factory in Cambridge, designed and manufactured instruments for experimental research in university and other research laboratories. Today, the company employs 2,000 people and manufactures a wide range of instruments.

There have been two particularly significant factors behind the extension of the firm's range of products over the years to include electrical, temperature measuring, engineering and analytical instruments. One of these factors has been an apprenticeship scheme through which instrument-making skills and techniques have been passed on and developed. The second factor has been the close relationship which the company has always maintained with universities and research bodies.

Many distinguished scientists and engineers have collaborated with the company in the past in designing instruments. Outstanding fairly recent examples of the success of such collaboration have been the Huxley ultra-microtome (developed with the Department of Physiology at Cambridge University), the dye-dilution curve recorder (Hammersmith Hospital) and, of particular significance for industry, the Microscan X-ray analyser (the Cavendish Laboratory and Tube Investments Research Laboratories).

Fig. 1 Testing a Microscan X-ray analyser in the new assembly wing.

This last instrument, which is used to investigate the microstructure of metals and minerals, has tremendous industrial potential and has already been a very useful dollar earner. Dollar earning, indeed, has been one of the significant characteristics of the company's trading over the past few years. Its American offspring, Cambridge Instrument Company Incorporated, of New York, is now earning more dollars each year than the total initial capital investment in it. Another example of the parent company's forward looking marketing policy is the new arrangement, reported in this weeks' Marketing feature, for manufacturing in Italy.

The fast development of new instruments by the research department and of new markets by the sales department have thrown upon the production management the responsibility for producing greater quantities of increasingly diverse and increasingly complex instruments. Production is divided between two factories in the London area—at Muswell Hill and at Finchley—and the factory at Cambridge.

The products of Muswell Hill include electrical measuring instruments, electronic recorders for use with temperature-measuring sensing elements,

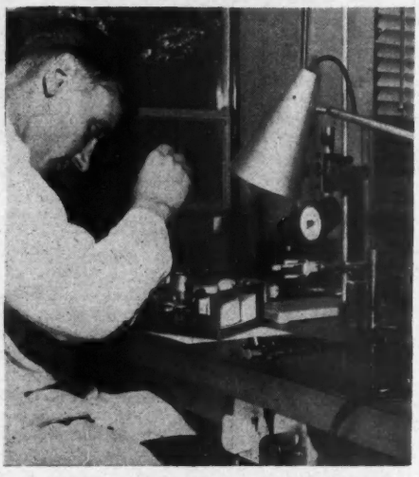


Fig. 2 Adjusting a taut-suspension galvanometer movement mounted in a 5 inch scale indicator.

pH instruments, dc precision potentiometers and bridges, galvanometers, and ac potentiometers and comparators. At Finchley, production is principally of a variety of mercury-in-steel temperature-measuring systems developed for industry, science and medicine.

With the opening of the new assembly wing at the Cambridge factory, the company's production facilities are greatly increased. All the production sections in the wing are approached through air locks, and the air supplied throughout the building is conditioned and filtered. A dust-free and air conditioned atmosphere is, of course, vital in instrument assembly.

One production department is responsible for the assembly and final testing of Microscan X-ray analysers and for the production of sealed flow-type proportional counters. This department also commissions and services Microscans and operates an advisory service which includes the analysis of samples provided by potential customers. Thus, in the complicated and intricate (and, often, one-off) instrument industry, production departments must undertake some work which is virtually applied research.

The instruments are assembled in adjacent individual cubicles, each of which is supplied with its own special services, and there is ample

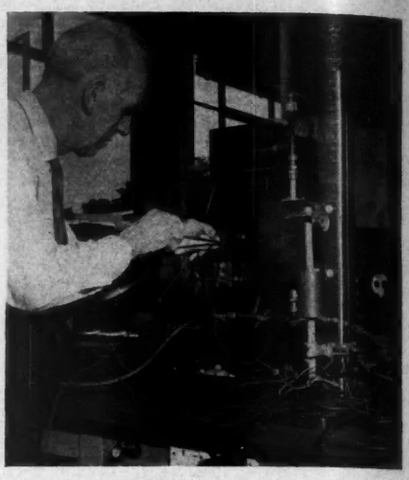


Fig. 3 Assembling and testing a new instrument for determining gases occluded in metals.

bench space for the final assembly and testing of components (Fig. 1). To meet the very high standards of cleanliness demanded for work in this department, the air supply passes through an additional filtration stage before being circulated.

Another department in the new building deals with galvanometers and various indicators, recorders and controllers. Under almost clinically clean conditions, these instruments are assembled, tested, calibrated, and packed in polythene containers ready for dispatch. Again, a filtered and dust-free atmosphere is necessary for the assembly of precision galvanometer movements, and modern *décor*, good lighting and specially designed work benches help to provide the conditions which are ergonomically necessary for this type of work. Fig. 2 shows an operator in this department adjusting a taut-suspension galvanometer movement mounted in a 5-inch scale indicator.

The electronic instrument department is also housed in the new wing, and is concerned chiefly with small batch production and making prototypes—another example of the company's research-mindedness, even in the production sections. Printed circuits and semi-conductor devices are used extensively to keep down the size of instruments and components. There is an adjacent department, primarily interested in medical equipment.

Production facilities in the new block are completed by the gas analysis department. In this department, a very comprehensive range of analysers of the thermal conductivity type is made. These include instruments for flue-gas analysis, the determination of the purity of rare gases, and the determination of hydrogen occluded in metals (Fig. 3). Indicators, recorders and controllers for use with meters analysing explosive or toxic gases are also produced, and the department assembles and calibrates instruments for the measurement of the dissolved oxygen content of boiler feedwater (by the very sensitive electrochemical gas transfer method) and meters for determining the oxygen content of gas mixtures (by measuring the mixture's paramagnetic qualities).

The very range of uses for which Cambridge instruments are produced nowadays is an indication of the fact that the company, whilst maintaining its long-standing pre-eminence in research, has, with the stimulus of progressive marketing, seen the necessity for setting up production facilities as complex and as sensitive as the products themselves.

Cambridge Instrument Company Limited, 13 Grosvenor Place, London, S.W.1.

Induction Heating for Con Rod Billets

Although the principle of induction heating has been established for many years, it is only comparatively recently that full advantage has been taken of it generally. Among the firms using it are Austin Motor Company, who now have a two-tunnel induction heater for the forging of manganese-molybdenum billets, the raw material of connecting rods for BMC engines.

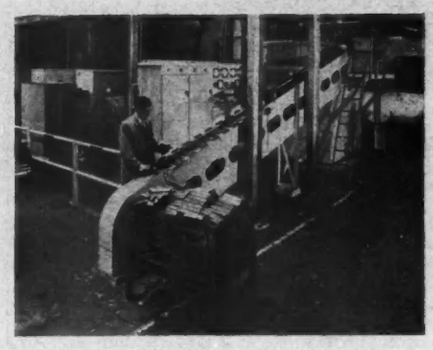
In this particular application, the new furnace will do twice the work of the three conventional oil-fired furnaces which it has replaced. The Austin engineers find it economic, efficient and clean, and, being very compact, it takes up a relatively small amount of floor space. Further, it provides cool working conditions.

The new furnace is capable of heating up to a temperature of 1,250° C, and is used solely in the heating of En 16 steel billets measuring $1\frac{5}{8}$ in square by $8\frac{3}{8}$ in long or $1\frac{1}{2}$ in square by $7\frac{7}{8}$ in long, each billet eventually making a pair of connecting rods. They can be discharged from each coil at a rate of one every 13-14 sec. Pneumatic interlocked pushers operate on a preset time cycle and load one billet into each of the two coils alternately.

The coils of the furnace are each 58 ft long and are formed from high conductivity water cooled conductors. Electrically, the billet heater is arranged as two independent units and can be run as a single-tunnel equipment if required to operate at less than 50 per cent capacity. For this same reason, the control panel, and similarly the power unit, are arranged in the form of two separate sets. On the panel are the mechanical handling controls the alternator regulators and the automatic power factor controls.

Automatic power factor correction is effected by switched capacitors mounted within the base of the furnace units, which also house the main isolating contactors and water-cooled matching transformers. Two 300 kW, 2,500 cycles per sec motor alternator sets are incorporated in the equipment, each consisting of a 485 hp induction motor mounted on a common bedplate.

The coil units are mounted above the control panel and are about 8 ft from floor level. As shown in the illustration, in operation, the cropped billets are loaded manually on to a flighted conveyor which delivers them to the coil charging position.



Loading the cropped billets on to a flighted conveyor for delivery to the coil charging position.

GWB Furnaces Limited, Dibdale Works, Dudley, Worcestershire.

Multiple Cell Plating for Odd Shapes

A special hydraulic return-type unit has been installed at the Coventry works of Triumph Engineering for the nickel and chromium plating of motor cycle rims and other accessories. Designed and installed by W. Canning and Company, the plant is said to be unique in employing the multiple cell plating principle.

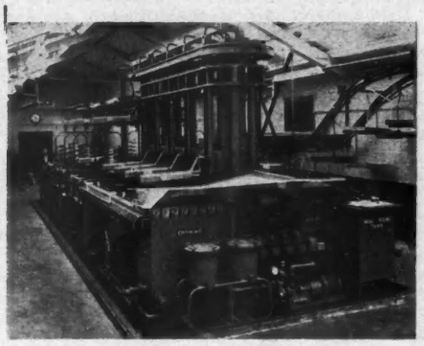
By this principle, the work is set down in one of eight different sections or cells, with the rims held horizontally in a jig and surrounding a fixed central core of nickel anodes. Since the work is stationary, the anodes can be positioned to give the most efficient current distribution. The introduction of this plant has enabled Triumph to increase considerably their output of plated motor cycle rims and at the same time ensure an exceptionally good and uniform finish, with very little wasted material. On a production of 40,000 rims the reject figure has been less than 0·1 per cent.

The plant (shown in the illustration) is 47 ft long, 13 ft wide and 12 ft high, and is basically in two sections. The first section comprises the cleaning and chrome plating tanks and swills—and is of standard "Trojan" design—while the second section is made up of the specially designed nickel plating tanks. The work arm is transferred between the two sections by an electrically actuated mechanism.

One operator is sufficient for loading and unloading the plating jigs, and the plant has an output of 48 rims per hour.

Appreciable economies in nickel consumption have resulted from using this new method, since it is no longer necessary to "overplate" repeatedly in order to ensure that the spoke band—which attracted least metal under the old manual system—receives a sufficient thickness. Previously, the rim beads attracted four times as much nickel as the spoke band.

It appears that automatic plant using the cell plating principle can be profitably applied to the plating of many components which are either of complex shape or need special anodes configurations, and for which, in the past, manual processing has been necessary to avoid undue variations in thickness of deposit.



Triumph Engineering's automatic plating plant which uses the multiple cell principle.

W. Canning and Company Limited, Great Hampton Street, Birmingham, 18.

Automatic Handling for Spraying Lines

Two production lines have been set up at ICI's Billingham factory to automatically marshal over 1,000 drums a day as they leave the last drum-making machine, and process them through paint spraying and into the drying ovens. The actual spraying is carried out in a double paint spraying booth which has manually operated equipment. Parts of one of the lines are shown in the illustration.

After the drums have been fabricated, they run along a floor level conveyor to be automatically sensed and fed alternately to one of the two spraying lines. The drums are pushed off the conveyor on to the lifting platform of an automatic lift unit.

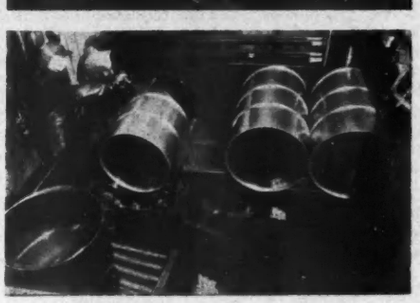
When the lifting unit receives the drum, it raises it and then disgorges it on to a set of inclined rails, along which the drum rolls to a waiting position adjacent to the spray booth equipment. Since this equipment must be adaptable to deal with a variety of sizes and types of drums, small elevator units are built into the rails to make for easier handling and inspection of awkward sized drums.

While the drums are awaiting spraying they are metered automatically on to a rolling frame by a device which holds drums on the end of the inclined rails until the previous drum has been sprayed and ejected from the spraying position.

During spraying, each drum rests on chimb rollers which rotate constantly at a set speed throughout the operation. There are two operators to each spray booth, one of whom sprays the outside of the drum, including the bottom, while the other sprays the drum internally. On the smaller size drums or on closed drums, only one operator is required. When the drum has been completely sprayed, one of the operators depresses a hand valve which elevates the cradle of the spraying frame, disengaging the chimb rollers from the drive. The drum stops rotating and is lifted into a vertical position and thence on to another conveyor which carries it, now newly painted, to the oil-fired furnaces to be put through the drying cycle. At this point, the two production lines converge on to a common conveyor.

With both booths in operation, the throughput of drums is over 1,000 per day, the maximum size of drum being 22 in diameter by 36 in long. When smaller drums, having a diameter of 14 in and a length of 18 in, are handled this throughput figure can be stepped up to 1,600 per day.

Since the equipment has been installed, the finish on the drums has been consistently better than with the previous manual handling system, and it is possible to apply different colours to the inside and outside.



The automatic handling equipment; (above) drums awaiting spraying; (below) during spraying.

The Hymatic Engineering Company Limited, Redditch, Worcestershire.

On the Shelf

By Frank H. Smith

THOSE telephone people don't half muck us about. First of all they take away the little barrel-organ handle at the side on which one could vent one's spleen when one could not get the operator. Then they take away the little earpiece rest, which was only slightly less satisfactory as a spleen venter. Then they make us automatic and dial-conscious, which causes us lots of boils and carbuncles because of no spleen outlet. Now there's this trunk dialling business where you talk by a stopwatch and have to alter your whole telephone technique. For a start, telephone operators will *have* to take requests to ring back. The other day the *Mirror* wanted some information from me. I said I'd ring back (model-of-courtesy stuff). I rang back and extension was engaged—three times. Under new STD (Subscriber Trunk Dialling) I would not hold on. But would operator take my number? Would he hell. So *Mirror* went without information and a Live Letter writer had a bit longer to wait.

The International Atomic Energy Agency (" to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world ") has published its publications catalogue for 1958-61. This can be obtained from IAEA, for whom the address is Vienna, 1: Kaerntnerring 11. Sales agents in this country a e HMSO, so perhaps they also do the catalogue.

Special Libraries Association (of America) apparently have ideas on how to sell themselves. They had a booth at the National Metal Exposition and Congress (Detroit, end of October) at which bibliographies, prepared by the Association's Metals Division, were either sold (at 75 cents) or given away. If this isn't a damned good way to put over librarianship I'd like to know what is. If the bibliographies are good, that is.

A catalogue with some rather unusual second-hand material and ideal for browsing through is that of H. Pordes, 138 New Cavendish Street, London W1. He is rather better provided in newspapers and periodicals, of the *Times* and *Nature* variety, than some. Runs of book indexes seem also to be his *forte*.

I was a little disappointed in *Mermail* (" a joint publication by the Mermail Group, a group of independent Dutch companies, well known as suppliers to the shipbuilding and shipping industry ") as the cover promised something after the style of one of the oil companies' prestige journals or the Vickers' job. It turned out to be a bit stuffy, though. One article was pleasing, on the history of shipbuilding. If you want to judge for yourself, try PO Box 1037, Rotterdam.

A long screed comes from British Welding Research Association, Abington Hall, Cambridge, which is tan amount to throwing their hat in the air and calling for three cheers. The reason is that their translation (sponsored by Big Brother DSIR) of the Russian journal rendered into *Automatic Welding* has been a resounding success, giving rise to such techniques in this country as electroslag welding and friction welding and the prospect of using steam as a shielding medium (you should see me trying to get some sense out of these publicity handouts). With this hat-throwing lark they sent an index to articles in the 1960 issues, and the price—10 guineas a year or £1 10*s* 0*d* for a singleton. So if you want to know about the electroslag surfacing of ferrous with non-ferrous metals, see what Svetlopolyanskii V.I., Gryazev, M. I., and Svetlopolyanskaya (she's different, you see), T. P., have to to say about it in No. 10.

If anybody wants to use a double wind-tunnel (what agony) they can get the use of one from English Electric Aviation. A booklet describing the facility is available from 100 Pall Mall, London SW1.

Design Outlook

Engineering Data for Product Design. Edited by DOUGLAS C. GREENWOOD. *McGraw-Hill, New York and London.* (77*s* 6*d*)

This is a lengthy manual of twelve chapters, each of which contains specialized contributions from authors in industry, and as many as 37 different subjects are dealt with under one chapter heading.

The book is basically a designers' manual and covers the important aspects in the computation for such members as shafts, gears, bearings, springs, and so on, as well as covering some electronic circuitry and developments, with a general introduction to control systems, both electronic and hydraulic/pneumatic. Many nomograms and nomographs are given for quick computation, all of a usefully large size, and a section is devoted entirely to an explanation of the use of break-even charts. Quite an astounding number of equations for design are also given, together with an explanation of the symbols, enabling the bulk of design data to be obtained readily; but no theory is given in the derivation of these, and unfortunately there are some special designs which would require this special knowledge.

Some of the subjects covered are quite difficult; for example, the chapter on vibrations, and it seems that unless the reader has at least a general knowledge of the terms used in the subject, he could not appreciate the methods used in the book, and the implications made. For example, in the case of the two-degrees-of-freedom vibration systems, a nomogram is given to determine the natural frequencies of the elements (undamped), but no reference is made to any of the possible applications of the system, such as its use as a " vibration absorber." Neither is any reference made to torsional vibrations, which seem perhaps more common applications.

Since, however, the book is directed at practising designers, rather than students, this is reasonable enough, and a further point which will enhance the qualities of the book from the design aspect is the excellent subject classification and index. Most of the information in the book is not new and is available from other sources, but it is gratifying to see it collected between two covers in such a concise and understandable manner.

Perhaps the most reasonable criticism of the book is its lack of consideration of the economic aspects of design and their probable effects on the designer. The section on break-even charts, for example, implies that these are the ultimate criterion for development of a product, and no mention is made of incremental costing, nor in fact, of any of the economic tools used commonly for decision making, such as total value analysis and operations research. In any case, this would not be easy to include as it stands; but perhaps the editor would consider publishing a supplementary book to this one, which would include these economic aspects?

To sum up, the book is of most use to the professional engineer engaged in design, where he will find very quickly most of his day-to-day information in a general form, with the minimum amount of " glossing." The book would also be most comforting to the recent graduate filling his first design post.

W. S. HORWOOD

How Many Rails?

Monorails. By HERMANN S. D. BOTZOW, JR. *Simmons-Boardman Publishing Corporation, New York; Ian Allan Limited, Craven House, Hampton Court, Surrey.* (21*s*)

In any group of people talking about the future development of transport the word " monorail " is sure to be heard sooner or later, whether the group is of experts or laymen. Despite the readiness with which the word is brought into conversation, however, there is nearly always a surprising vagueness as to the actual construction and performance of monorails and therefore of what they may be expected to do. In the USA, especially, as the long list of proposals and schemes of recent years shows, it has sometimes been difficult to get civic authorities to believe that " modernized rapid transit " for their cities does not necessarily involve planning a monorail.

The fact is that monorails are nearly as old as orthodox railways—the first on authentic record, patented in 1821, was built by Henry Robinson Palmer, Engineer to the London Dock Company, in 1824 (probably) to operate between Thames-side and the Royal Victualling Yard. Certainly Palmer had a second of these horse-drawn lines carrying bricks across the Cheshunt marshes in 1825 and this had carried passengers in a special car on the opening day. From this historic (and British) start, dismissed, incidentally, in a very few words indeed in his book, Mr. Botzow sets out to define, codify and classify the main characteristics of the various monorail systems which have appeared in the last 140 years or so, and to set down the main facts which any serious student of the subject should know. It should be said at once that in this general purpose he succeeds admirably. If the style is not always easy to read it is doubtless because this book started life as a thesis for a Master of Science degree; it will not deter anyone with a genuine interest from reading it.

The value of the book is enhanced because, as Professor Lang of the Massachusetts Institute of Technology states in a foreword . . . " we have little reliable information on the subject, because no-one has yet taken a look at it which attempted to be at once objective and relatively simple." Not all Mr. Botzow's information is reliable, but at least he has made a brave attempt at a very difficult task. The book is as up to date as it could be at the time it must have gone to the printer and the author's comments are generally sensible and to the point. There is no attempt to show monorails as being more efficient than they really are and the temptation to be swayed by the sometimes extravagent claims of inventors, and, still more, promoters, has been avoided.

What is the real future of the monorail? With Mr. Botzow's help the reader can make a good attempt at answering the question for himself. He is likely to come to the conclusion, especially if he has a good knowledge of ordinary railways, that it has yet to be proved that a monorail can do anything which an orthodox two-rail line, especially with really lightweight stock, could not do equally well. Much claimed for the monorail is the result of the application of modern engineering techniques and materials—sometimes from the aircraft and automobile fields—to their design. A monorail is intended to operate on its own reserved track and has no need to be compatible with any existing system. A two-rail train, using orthodox track, designed on the same principles could almost certainly do just as much as, and more than, any monorail yet designed. Why should such a train have to have all the features needed to make it compatible with the normal heavy rolling stock used on railways? Why not 20-, 15-, or even 10-ton railway cars? Senator Hastings and his associates in the USA have already designed a 50-ft split-level car with four 100-hp electric motors which weighs only 17 tons, and 60 ft of Talgo train (three sections) weighs only 10½ tons and yet runs happily at high speeds over not very good track in Spain. Rubber tyres, for which much is claimed by monorail promoters, can be applied equally well to two-rail vehicles.

Two of the most promising current monorails,

the French SAFEGE system and the Swedish-German-American Alweg, are not really monorails at all. The SAFEGE is a "split-rail" system with twin running surfaces, using four-wheel bogies from which the car is suspended. The Alweg system, although using a single massive concrete beam, which the car straddles, as both track and support, uses no less than five bearing surfaces and is a direct descendant of the Lartigue system as developed by Fritz Bernhard Behr. Mr. Botzow, unhappily, does not accord either Lartigue or Behr the credit which is undoubtedly their due. Behr, a pupil of Sir John Fowler, is to the monorail what George Stephenson is to the steam locomotive. In 1897 he had a British-built, electrically-driven, 55 ton monorail car careering round a three-mile track near Brussels at 83 mph, and his proposed Liverpool-Manchester line, duly authorized by Parliament in 1901, came very near to being built. The 20 minute journey time which it would have given between the two centres has still, after 60 years, to be realized by any other form of transport.

All in all, imperfections though there may be, Mr. Botzow's book should be on the shelves of every progressive-minded railway and urban transport man. The Alweg lines now in operation at Disneyland and those built for the Turin and Seattle exhibitions are doing real work, not just giving demonstrations, and the public are having a chance to try other systems in the USA and Japan. That fine old veteran, the Wuppertal line, still goes smoothly, if not silently, about the work it has done for 60 years. Demonstration lines are in Germany, France, and Japan and maybe elsewhere—Russia has plans, certainly, at the very least.

Even if today's verdict is to be "Not Proven," tomorrow's may be different. To follow up some of the references in the excellent bibliography—provided in part by the Research Information Division of the British Transport Commission—which ends Mr. Botzow's book is to wander in wonderland. Like all wonderlands, it can be very stimulating to the imagination.

Monorail progress has been so rapid in the last two or three years that a second, revised edition of the book could well be undertaken immediately. If it is, it is to be hoped that the publishers will allow space for a more comprehensive index, essential in a book of this nature.

J. R. DAY

For Generation or Propulsion

Plasma Acceleration. Edited by SIDNEY W. KASH. *Stanford University Press, Stanford, California; Oxford University Press, London.* (34*s*)

Plasma physics is a branch of physics which has undergone a mushroom growth over the past ten years. It has grown out of a branch of classical physics, gas discharge physics. (The term "plasma" was borrowed from medical terminology in the 1920's by one of the greatest gas discharge physicists, Irving Langmuir, to describe those parts of a gas discharge in which the ion density is so high that space charge forces keep the electron and positive ion densities approximately equal.) The plasma physicist differs from the classical gas discharge physicist in that he is generally interested in much higher current discharges, and hence higher degrees of ionization than the latter, and he is particularly concerned with the interaction of the ionized gas with magnetic fields.

The original cause for the growth of this subject was the possibility of producing thermonuclear power from heavy hydrogen, and plasma physics aimed at this ultimate goal is still the largest branch. Over the past few years it has become apparent that the road to useful power will be a very long and arduous one because of the difficulty and complexitity of plasma physics. This might have caused a slowing up of the growth of the subject (from the manpower point of view), had it not been for the appearance of two new prospects. These are in the field of direct conversion of heat to electricity—the magnetohydrodynamic generator and the plasma diode—and in the field of propulsion in outer space.

Plasma acceleration, the subject of this book, is connected with both thermonuclear research and with propulsion. It is concerned with devices (plasma "guns" and "jets") aimed at accelerating to high energies either blobs of plasma or continuous streams of plasma. This is of interest to the thermonuclear physicist, because one of the ways of producing a very high temperature gas is to fire a high velocity blob of plasma into a confining magnetic field where the ordered motion will be converted into thermal motion.

In the field of propulsion, plasma acceleration is of interest because of the high velocity which can be achieved. By firing off a high velocity plasma jet, a space vehicle can achieve a greater impulse per unit mass ejected than is possible in the case of a chemical fuel rocket jet. The energy required per unit of impulse is higher, but provided solar or nuclear energy is used an overall reduction in weight can be obtained. The powers envisaged for such plasma jets are puny compared with the power of the chemical rocket motors which launch space vehicles through the earth's atmosphere. Their use would be rather for acceleration and navigation in outer space. Thus as pointed out by one of the contributors to this book, Conrad Longmire, an acceleration of only 1 cm/sec², if continued for, say, ten days, will produce the impressive velocity of 18,000 mph, and ten days is not long compared with the several months needed for a trip to Mars or Venus.

For either eventual application, plasma acceleration is a very recent subject and is only in the very preliminary stage. This book contains nine papers by experts in the field on the basic principles, on the proposed designs for some plasma accelerators, and in two cases with results obtained in initial experiments. These papers were read at the Fourth Symposium on Magnetohydrodynamics sponsored by Lockheed's Missiles and Space Division on 2 December, 1959. In most cases the acceleration method involves inducing an electric current in the plasma at right angles to a magnetic field, so that the $j \times B$ force can be utilized. In one case, however, a method is proposed which is based on accelerating positive ions by an electric field, the ions being subsequently neutralized with electrons.

This book is primarily of interest to those connected with this field, but it is such a new subject that the experts' papers have not yet become too complicated. Several of the papers deal with the basic principles fairly simply and are readable by the general technical reader. In any case, as far as is known to the reviewer, no other book has been published on this new subject, and the interested reader has therefore no choice.

A. A. WARE

Coal and People

Industrial Growth and Population Change. By E. A. WRIGLEY. *Cambridge University Press.* (32*s* 6*d*)

In the nineteenth century coal was the basis of all industrial change and development. Without it the steam engine and the coke-fired blast furnace would have been impossible. But at the same time because of its bulkiness and the vast quantities needed by industry, the geographical situation of the coalfields decided the location of industry. The nearer the steel works could be to its source of fuel the lower was its cost of production. This domination of the economic and social life of a region by coal happened on the Continent as well as here in Britain. In particular it was responsible for the development of the continuous industrial belt stretching from the Pas de Calais across Southern Belgium to the Ruhr. This region, the biggest industrial area on the Continent, was based on the Nord, Pas de Calais, Hainault, Liège, Aachen and Ruhr coalfields. The area developed during the great period of industrial dependence on coal from about the middle of last century to the beginning of the First World War. What was the effect of industrial development on the population living in the region? Was there any clear connection between the growth of industrial production and the growth of population?

This is the problem dealt with by E. A. Wrigley, in his interesting new book, *Industrial Growth and Population Change*. The author is a lecturer in geography at Cambridge University. He divides his book into two parts: the first deals with the rapid industrial growth in the North West European coalfield, the other relates this to population changes in the area, and the sources of population increase there.

To anyone who knows the North West coalfield area today under the European Coal and Steel Community the story told here of its development from 1850 to 1914 makes fascinating reading. In 1950 Belgium was the dominant producer in the area both for coal and iron. The pits of Hainault and Liège had an annual output twice as great as the French and Ruhr coalfields combined. And the Belgian iron makers were turning out three times as much as the French and twelve times as much as the German plants in the region. It is also interesting to find that the Belgians were technically ahead of their neighbours and had the first coke-fed blast furnace and a long lead in woollen textile machinery. The most famous name associated with Belgium's early industrial development is that of an Englishman William Cockerill whose name appears today in the great Cockerill-Ougrée coal, iron and steel complex. Belgian influence also spread across the frontiers into France and Germany through the movement of key men, ideas and capital. As the nineteenth century progressed the level of activity in Germany increased and the great firms of the Ruhr area were founded. But the route by which the new techniques and machinery reached the Continent from Britain continued to be through Belgium until the end of the century.

In seeking to establish a connection between industrial growth and population increase Mr. Wrigley has carried out a great deal of meticulous research on the national occupational censuses for different industries, records of coal output, consumption and export. He concludes that coal was the key to the pattern of development and that rapid industrialization took place in areas where it was plentiful, even when industrial methods were previously unknown. At the same time an area well supplied with labour and industrial traditions such as the flax producing area of Flanders went into decline for lack of coal.

This initial pattern was gradually superseded as other factors came into operation. The size and scale of activity in the Ruhr iron and steel industry made for economies in other directions and meant that more money was available for research and development. It is no accident that the chemical, electrical and engineering industries developed there while Belgium and France settled down to a quieter pace of economic growth. One of the consequences of Belgium's early start was that the mines became worked out at a time when those of Germany were still developing. The troubles in the Borinage last year stem from those early days.

One of the many interesting topics raised in this book is the relationship between fuel reserves and prices. W. S. Jevons, the economist writing a century ago, was afraid that industrial development in Britain would outstrip coal production. The discovery of more easily transportable fuels has to some extent overcome this problem at the international level. Internally the conversion of natural fuels into electricity has made it possible to set up industry away from the coalfields. Indeed, some of the most efficient and economical steel works in Europe, notably Ijmuiden in Holland and Cornigliano near Genoa are deep-water plants importing all their fuel and raw materials. Now that coal prices are relatively high in Britain the question of how to best use our remaining reserves becomes increasingly important. In some sectors, in particular the power stations, demand for coal can be fairly accurately anticipated. Elsewhere traditional users of coal are turning to oil or electricity.

The industrial market for coal is an extremely complex one and nothing is gained by over simplifications about the superiority of other fuels. The increased availability of oil since 1956 has set in motion a movement against coal that is still going on with cost as one of the major factors involved. The situation of the North European coalfield of a century ago is now reversed. Then development took place where the fuel was available most cheaply. Today it is an easy matter to provide fuel where labour, raw materials or communication facilities make development desirable. The old industrial areas of Britain as well as North West Europe are today paying the penalty of early development in the different industrial environment. When we read however, that a steel company in South Wales, an area of abundant coal, has asked the Minister of Power for permission to import cheaper American coal, the wheel seems to have turned full circle.

RICHARD BAILEY

Ultrasonics in Outline

Basic Ultrasonics. By CYRUS GLICKSTEIN. *Rider, New York; Chapman and Hall, London.* (32*s*)

This book sets out to describe the application of ultrasonics in modern industrial processes. It is perhaps not appreciated how widely the use of ultrasonic energy has been extended since the last war.

Broadly, the two main categories of ultrasonic techniques are those in which the energy is applied at comparatively high power levels to aid a chemical or mechanical process, and those in which it is used in the form of short pulses for echo sounding.

In the former group, use is made of the very high accelerations that occur when a mechanical vibration is introduced into a liquid or solid, in the ultrasonic range between say 20 and 1,000 kc/s. At a power level of more than ½ watt per cm² in water, a phenomenon known as cavitation occurs causing the continuous formation and collapse of millions of microscopic vapour bubbles. The collapsing bubbles act as tiny implosions releasing tremendous pressures of hundreds of atmospheres. Although not fully understood, the effect of cavitation, or of high particle acceleration can be to break down molecules or to remove particles which cannot apparently be done by conventional mechanical means. Therefore the introduction of ultrasonics particularly for cleaning purposes has been steadily increasing for some time.

Another extremely interesting application, not yet in common use in this country, is ultrasonic welding, particularly for thin aluminium foil or sheet. Ultrasonic drilling and soldering is also widely used. So far as the reviewer is aware, there are very few industrial applications to chemical processes although there are many reports in the literature of successful small scale experiments on such processes as tanning, the artificial ageing of whisky and the like.

The two most widely used applications of pulse techniques are in ships echo sounding, and in flaw detection. Following Langevin's original work the former is now completely accepted and portable models are even available for yachtsmen, while extension of the technique to submarine detection, and later to fish shoal location is also well known. In some cases, the pulse technique is used for liquid level measurement in chemical plants, particularly where other methods are difficult to apply.

In British industry the use of ultrasonic flaw detection particularly in metals is widespread. As a complementary technique to X-rays and other forms of non-destructive testing, it has established itself as an extremely valuable tool, thickness measurement and determination of elastic constants by measuring the velocity of sound in a material, being other applications.

This book describes all these and many other examples. The material is simply presented and there are questions at the end of each chapter which enable the reader to check on his understanding of what he has read.

For anyone working in the field of ultrasonics, the treatment is too superficial for the book to be of much value, but as a simple popularization and general review, it can be read with great interest. The main criticism is that not enough explanation is given of the difficulties and limitations involved so that a slight impression of a new " wonder technique " is given.

L. H. WELLS

Trade Publications

Copies of any of the following trade publications are obtainable from the addresses given, though distribution is sometimes restricted.

Equipment

Pilot Valves. MAXAM POWER LTD., Camborne, Cornwall. A data sheet giving dimensions and details of four types of two-position pilot valves. Two of these valves have push-button attachments and two are provided with roller attachments. Ill.

Chemical Control Units. WALLACE AND TIERNAN, LTD., Power Road, London W4. A brochure giving information on a selected number of chemical control units, applicable to a variety of industries. 8 pp., illustrated.

Fluxing and Soldering Machines. FRY'S METAL FOUNDRIES LTD., Tandem Works, Merton Abbey, London SW19. A folder on the Flowfluxer for the automatic fluxing of printed-circuit panels, and the Flowsolder machine designed to solder these panels automatically. Illustrated.

Milling Heads. ATELIERS SMID S.A., 25 rue des Roses, Mulhouse, France. Leaflets and data sheets relating to a range of milling heads produced for use on suitable machine tools. Illustrated.

Airheaters. NU-WAY HEATING PLANTS LTD., Droitwich, Worcestershire. A folder describing Econoil X19 and X24 oil-fired airheaters. These heaters are offered for use in small works, garages of transport undertakings, horticulture, and agriculture, among other applications. Illustrated.

Programming. ENGLISH ELECTRIC CO. LTD., Metal Industries Division, Stafford. A brochure describing an automatic programming system, applicable to rolling mills, which employs punched cards. Details the equipment required and the operating procedure. 11 pp., illustrated.

New Books

Value Engineering. Volume 2. Edited by RICHARD S. MANDELKORN. *Engineering Publishers, Elizabeth, New Jersey. Distributed by Reinhold, New York; Chapman and Hall, London.* (67*s*).

Based on the Second Electronics Industries Association Conference on Value Engineering (Anaheim, California), this is a collection of 24 specialist contributions showing how the principles of value engineering are applied to reduce the costs of manufactured products while maintaining—and even improving—the quality.

Boundary Layer and Flow Control. Edited by G. V. LACHMANN. 2 Volumes. *Pergamon Press.* (£10 10*s*)

The entire field of the subject, together with many related topics, is encompassed in this collection of 40 contributions by internationally recognized experts. The material is organized within 4 main sections: History of boundary layer and flow control research in various countries; Boundary layer and flow control to prevent separation and/or increase lift in subsonic flow; Boundary layer control for low drag; Shock-induced separation and its prevention by design and boundary layer control. Much new work is reported, e.g. the calculation of sucked boundary layers in two- and three-dimensional flow, and boundary layer separation control in the presence of shock waves.

Aerofoil Sections: Results from Wind-Tunnel Investigations; Theoretical Foundations. By FRIEDRICH WILHELM RIEGELS. *Butterworths.* (£10)

Translated from the 1958 edition of *Aerodynamische Profile*, this is a detailed survey of all the principal theories and many of the experimental investigations relating to two-dimensional flow about a wing profile. A vast amount of data on the geometrical and aerodynamic characteristics of all the well-known profiles are presented in tables and graphs.

Prestressed Concrete. By JAMES R. LIBBY. *Ronald Press Company, 15 East 26th Street, New York 10.* ($12·50)

Designed primarily as a working guide, the book offers a comprehensive treatment of the theoretical and practical aspects of analysis, design and construction in prestressed concrete. The methods of flexure analysis are developed and their application to the design of structural members is demonstrated. Prestressing plant facilities, construction methods and equipment are fully discussed.

The Reviewers

Mr. W. S. Horwood, B.E., G.I.Prod.E., is Deputy Education and Technical Officer of the Institution of Production Engineers.

Mr. J. R. Day, A.M.Inst.T., Assoc.I.R.S.E., was for many years a practising railwayman. Subsequently he was on the staff of a railway magazine and more recently has been employed in transport publicity. He is the author of several books on railways, both usual and unusual.

Dr. A. A. Ware is leader of the thermonuclear section, at the Associated Electrical Industries Research Laboratory. At Imperial College in 1947, under the direction of Sir George Thomson, he was the first person to undertake experimental research aimed at controlled thermonuclear reactions. He is a Fellow of the Physical Society and an Associate of the Royal College of Science.

Mr. Richard Bailey, is an economist and the Director of P.E.P. He is also a regular broadcaster on economic affairs.

Mr. L. H. Wells, B.Sc., is head of research at the Ultrasonoscope Company (London) Limited. He is an Associate of the Institute of Physics.

Marketing

Far East Contracts for John Thompson Group

The market in the Far East has long presented a challenge to industry in the UK and one concern that has met it successfully is the JOHN THOMPSON GROUP whose companies have received contracts from that quarter worth nearly £2 million during the last nine months.

In achieving this, the company has followed the advice of its own chairman, Sir Edward Thompson, who recently headed a trade mission to South East Asia. On his return Sir Edward said that there was a vast market for capital and consumer goods, but many British companies were failing to meet the challenge of new conditions in the area.

An important contract has been won by JOHN THOMPSON COMPOST PLANT LIMITED, who are to supply a refuse-composting plant in the Tjempaka-Putih development area of Indonesia. Valued at about £760,000, the plant is capable of hygienically transforming 300 tons per day of crude refuse into organic compost, a valuable agricultural fertilizer. The specification has been specially designed to suit the prevailing site conditions.

In the boiler field, one of the company's chief interests, JOHN THOMPSON WATER TUBE BOILERS LIMITED are to supply three such boilers and ancillary equipment to a power station in Malaya and others have been ordered by a lumber company and a sugar factory in the Philippines. In addition, JOHN THOMPSON (WILSON BOILERS) LIMITED are to install two "Multipac" packaged boilers at the Queen Elizabeth Hospital in Hong Kong.

To strengthen their representation in the Far East, a branch office is to be opened in Kuala-Lumpur at the end of the year managed by Mr. V. Colley, a John Thompson director who previously represented the Group in India.

Steel Stock Warehouse

HALL AND PICKLES LIMITED, a member of the HALL ENGINEERING GROUP OF COMPANIES, have opened a new steel stock warehouse at Oadby, near Leicester.

Standing on a 1½ acre site, the building cost £80,000 and with a floor area of 24,000 sq. ft has a capacity of some 4,000 tons of steel of all types. Ease and speed in loading has been a prime consideration in the design, and the wide concrete approach roads allow lorries to manoeuvre and enter the building where the latest overhead handling equipment covering the entire floor area is employed.

The warehouse is the first of its kind in the area where the majority of users are small concerns unwilling to stock large quantities of steel and therefore anxious to obtain supplies at the minimum of notice. A complete turnover of stock is expected at least five times annually.

A service such as this should result in a considerable saving in overheads and capital for the steel user, as the cost of holding excessive stocks of steel in the user's yard is generally estimated at 20 per cent above the steel maker's price. The cost of rolled steel products obtained through the service of the stockholder in basis quantities, is said to average only 10 per cent above the maker's price.

At the opening ceremony on the 25 October, Mr. Nicholas Hall, chairman of the company whose activities also embrace the manufacture of an extensive range of high speed steels, alloy steels and cutting tools, spoke of the coming of the European Common Market. He said he welcomed it, speaking not only in the interests of his own company, but for industry as a whole. He felt it was a challenge which could and must be faced by employees and management alike, the much-needed tonic for British industry.

New Laing Development in Euston Road

A site at the junction of Euston Road and Duke's Road, London WC1, is to be redeveloped by the LAING DEVELOPMENT COMPANY LIMITED at a cost of £600,000 with the construction of a ten-storey building comprising 64,000 sq. ft of office space and 32 flats on the upper four floors. Work on the project will be started shortly by JOHN LAING CONSTRUCTION LIMITED and the completion date is scheduled for the middle of 1963.

Full air-conditioning is a feature of the design and this will employ a high-velocity perimeter induction system which obviates the necessity for open windows with the associated discomfort of fumes, dirt and noise. The flats, which will be served by a 13-passenger lift, will be equipped with electric underfloor heating and individual electric water heaters. Three more lifts running up to the fifth floor only, will serve the offices. Outside amenities include parking facilities for 44 cars on the lower ground floor, eight lock-up garages and a petrol filling station at ground level.

Reinforced concrete is to be used for the framework of the building and a constructional feature will be the use of the "Laingwall" system of prefabricated cladding units. Large storey-height precast concrete wall sections, complete with cladding panels and finished internally will be erected in one operation. The finish of the exterior will be modern and attractive making full use of marble, exposed aggregate and mosaic.

The architects responsible for the design are Russell Diplock Associates and the quantity surveyors are E. C. Harris and Partners. One of the initial phases of the project, the boring of 40 ft under-reamed piles, has already been carried out by MCKINNEY FOUNDATIONS LIMITED.

Sunbeam Alpine to be Assembled in Italy

Another link has been established between a British car manufacturing Group and a motor concern within the Common Market.

The two companies concerned are the ROOTES GROUP and the Italian firm of CARROZZERIA TOURING SUPERLEGGERA who have signed an agreement for the assembly of the Sunbeam Alpine sports car at an entirely new 300,000 sq. ft. plant in Milan.

The cars, which are already one of the best selling British sports cars in Italy, will be assembled from components produced at Rootes plants in Britain. A reduction in price is expected as import duty, at present levied at 35 per cent on complete cars, will be applicable only on the cost of components and not on labour costs as well.

The plant is scheduled to be in operation by the end of the year and the first cars are expected to leave the production lines early next spring. At the same time, Rootes Italia SpA, the firm's Italian sales and service subsidiary, will be strengthened and enlarged.

Announcing the agreement in London, Mr. Brian Rootes, the managing director, said: "I am confident that this agreement will greatly strengthen our competitive position and lead to a considerable sales increase in one of Europe's key markets.

"It gives us at Rootes particular pleasure to be associated with a company which has such an outstanding reputation for high quality, and there is no doubt that the Sunbeam Alpines built in Italy will maintain the highest standards of craftmanship."

The Italian Company is one of Italy's best known coach-building concerns and has established a reputation for specialist bodies built for high performance cars including the British Aston Martin DB IV, regarded by many as one of the most beautiful cars in the world.

Mr. C. F. Bianchi Anderloni and Mr. Gaetano Ponzoni represented the company at the signing, stating afterwards: "Despite the constant expansion of our activities, we have remained a privately owned company taking the greatest pride in our products. We are therefore, happy to be associated with a British company which also lays such great emphasis on quality."

Machine Tools Stand Firm

Shown below are the latest trade figures released by the MACHINE TOOL TRADES ASSOCIATION for the month of July. They are based on the returns of firms accounting for about 75 per cent of the total market and estimates have been made for the smaller concerns who do not make a monthly return.

The overall position remains favourable and new orders from overseas continue their upward trend, being 35 per cent greater than a year ago. Substantial orders have been received from Western Germany, and that country has now replaced Australia as the industry's second largest market in terms of order book. India, making vast strides in her development programme, has the most orders on hand.

Also in the east, Japan continues to be within the first six and steadily increasing orders from that quarter are providing rich dividends for firms who have made efforts to exploit the market.

New orders from the home market are still the least favourable aspect of the industry and the downward trend continues unabated. July figures are 26 per cent less than last year, making a decrease of 20 per cent in the first seven months of the year compared with the corresponding period in 1960. The continuance of this decrease is probably a reflection on the reaction of the home market to the "little budget."

The delivery position remains bright and the figures for the year, so far, show increases of 33 per cent and 28 per cent for the home and export markets respectively. Some reduction, however, is apparent in the July figures, especially at home, probably attributable to the fact that the month comes at the height of the holiday season.

Machine Tool Orders and Deliveries £'000

	Home		Export	
	July, 1961	July, 1960	July, 1961	July, 1960
Deliveries during month ..	7,386	6,196	2,559	2,336
Order book at month end	85,266	71,829	30,275	21,231
Net new orders	7,938	10,733	4,272	3,158

Anglo-Italian Company to Make Instruments

Arrangements have been finalized between the CAMBRIDGE INSTRUMENT COMPANY LIMITED and INSTRUMENTI DI MISURA CGS, SpA, Monza (Milan, Italy) for the formation of a new joint company, CAMBRIDGE-CGS-SpA.

Each company will have an equal share in the issued capital of 300,000,000 lire and the factory will be located at Casoria near Naples adjoining an existing production plant of the Italian company.

CGS, which emanates from a company founded over 65 years ago by Camillo Olivetti, employs over 1,500 people engaged on the manufacture of a comprehensive range of electrical measuring equipment for use in both industry and the research laboratory. Included in the range are switchboard and precision indicators and recorders, instrument transformers of all types and supply meters. Proud of its long-standing traditions, it has been associated with many distinguished electrical engineers and scientists among whose number are Vallauri, Campos, Nobili, Semenza and Barbogelata.

Initial production will be to Cambridge designs although certain adaptations will be necessary to meet the requirements of the Italian and neighbouring markets. The range will include electronic and galvanometric indicators and recorders for a wide range of applications, and associated control equipment. Marketing and distribution will be the responsibility of CGS and SOC. ING. TARAGNI and C., the latter having acted for many years as agents for Cambridge in Italy.

The new factory is expected to be complete by December, 1962, but in the meantime training of personnel and preliminary manufacture will be carried on at the Casoria works.

The Paxman Rotary Vacuum Drum Filter

A product which exists in many forms, each designed to meet certain specific conditions, matches the aim to provide a complete filtration service.

THE word "filter" suggests either one of the dullest engineering products imaginable, or a traffic manoeuvre. To apply the term to the Paxman rotary vacuum unit really does it an injustice, since this machine represents the art of filtration in one of its most sophisticated forms.

The rotary vacuum filter alone cannot be regarded as the sum total of Davey, Paxman's interest in filtration, though it serves as tangible evidence of a complete filtration service aimed at the process industries. Filtration problems are brought to Paxman and their engineers provide a solution based on the rotary vacuum system. But for certain kinds of filtration, the vacuum method is inherently unsuitable, domestic water supply in particular.

Filtration can best be described as the separation of two phases—solid or liquid from solid or gas. Liquid filtration, the function of the Paxman rotary vacuum machine, may be defined as a process to separate solid particles from a suspension in liquid (a slurry), by forcing the liquid through a filter medium in which the pores are too small for the solids to pass. The applied force may simply be gravitational, but it is more usually provided by evacuating the space on the downstream side of the filter medium, or applying a pressure upstream.

In the simplest terms, suppose that vacuum is used to draw the slurry through a filter in the form of a simple flat plate or box. As the solids coating or "cake" builds up on the box, its thickness will progressively increase until it becomes virtually impossible to maintain any liquid flow at all. Before this point is reached, it becomes necessary to interrupt the process while the cake is removed. The beauty of the rotary system is that by making the filter in the form of a slowly turning hollow drum, any point on the periphery of which is subjected successively to filtration, cleaning off the cake, and "blowing off," the process becomes continuous and almost eliminates any manpower requirement.

Interest first became focused on converting liquid filtration from an intermittent to a continuous process about a century ago, and the drum filter was the subject of several inventions. One of the earliest is described in an English patent issued to William and James Hart in 1872 was intended for "the drying of sewage precipitates, cement, paper pulp and other fluid or semi-fluid matters, using a revolving drum, the periphery of which is formed of wire gauze or other straining medium."

The drum interior was "divided into chambers which are successively brought by the revolution of the drum into communication with suction and forcing pumps, so that the matter being treated is continuously drawn on to the said drum, dried and removed therefrom at different portions of its periphery . . ." Many present day features were shown. But it was 1908 before such

Fig. 1 Welded Stainless steel drum.

filters first appeared on the market in the USA, and twenty years later when they reached Britain.

Davey, Paxman did not start making them until the early 1930's when, badly hit by the depression, they were urgently seeking new outlets. Always an adventurous firm with a long record of technical pioneering both successful and otherwise, they were destined to develop the vacuum filter gradually until today filtration has become one of the more important sides of their business.

EARLY ACHIEVEMENTS

Today the contrast between vacuum filters and Paxman's other longer-established activities is not so great as it was in 1931, due to a definite swing towards the chemical industry after the Second World War. The company originated in Colchester in 1865 under the name of Davey, Paxman and Davey for producing agricultural machinery, locomotive type boilers and steam engines. One of their early achievements was to start using steel for locomotive fireboxes instead of Lowmoor iron; and they launched the first of their now-famous patent Economic boilers in 1875.

They were early in recognizing the potential of the heavy oil engine as a serious competitor to the steam engine, and started producing horizontal engines for stationary usage in 1914. Marine units were being turned out at the time of the depression and their entry into the vacuum filter field. In 1939 boilers were still going strong and Paxman diesel engines were in full production for marine, rail traction and industrial duties. Vacuum filtration plant had also been produced in some quantity, mainly for de-watering caustic lime used in paper making and the outgoing coal slurry from colliery washing plants.

That the de-watering role of vacuum filtration plants is still the most important may appear surprising; but one of the advantages of vacuum filtration is that the process can be aimed at recovery of either the liquid, or the cake, or both. In fact, the variety of substances, some highly valuable, which are capable of responding to this treatment is extremely wide. Often the removal of a greater part of the moisture from a slurry by mechanical means shows a great

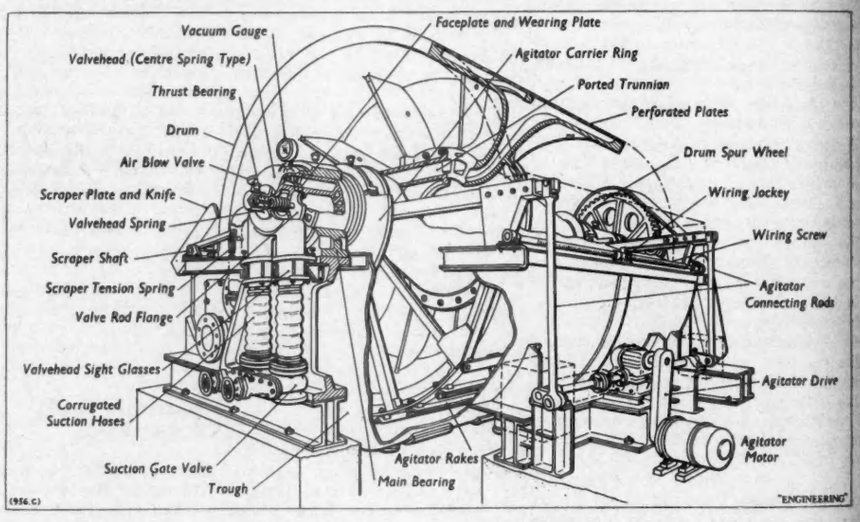


Fig. 2 (above) Standard filter, non-driving end.

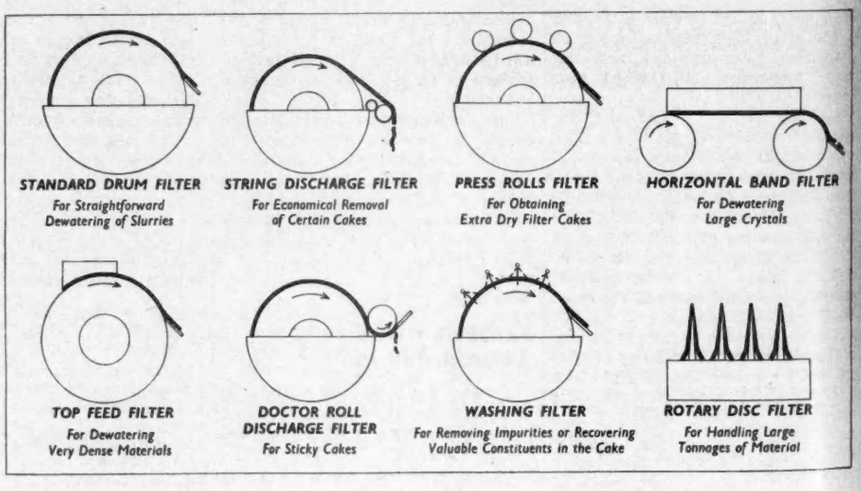

STANDARD DRUM FILTER
For Straightforward Dewatering of Slurries
STRING DISCHARGE FILTER
For Economical Removal of Certain Cakes
PRESS ROLLS FILTER
For Obtaining Extra Dry Filter Cakes
HORIZONTAL BAND FILTER
For Dewatering Large Crystals
TOP FEED FILTER
For Dewatering Very Dense Materials
DOCTOR ROLL DISCHARGE FILTER
For Sticky Cakes
WASHING FILTER
For Removing Impurities or Recovering Valuable Constituents in the Cake
ROTARY DISC FILTER
For Handling Large Tonnages of Material

Fig. 3 (below) A few of the many varieties.

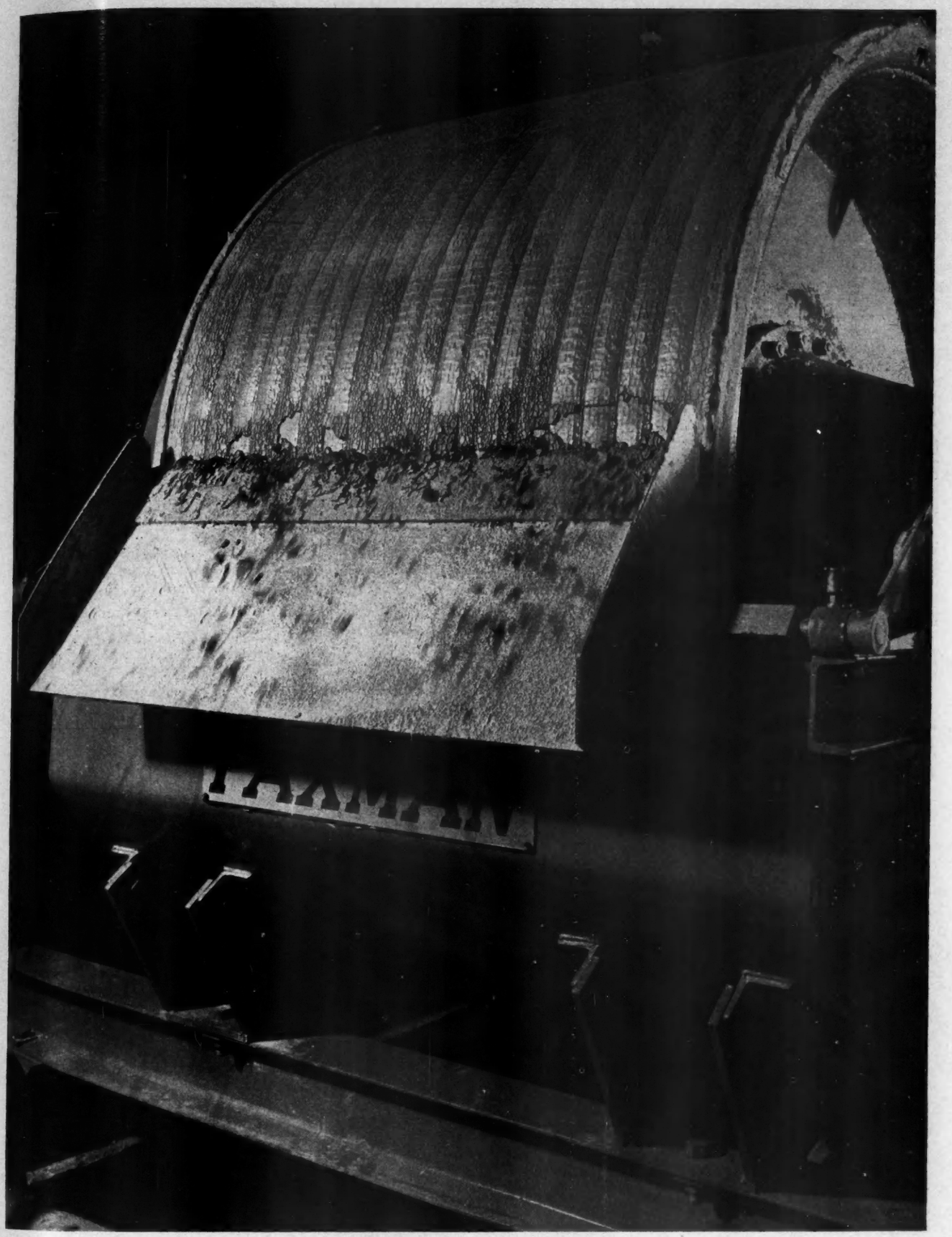


Fig. 4 Where success may be traced to foregoing the benefits of standardization in favour of a policy of "performance first".

saving in cost over the alternative of applying heat, and results in a substance more convenient to handle and reduced in bulk.

After the war Davey, Paxman continued where they had left off in 1939. The wisdom of their swing towards the rapidly expanding chemical industry has been reflected in their increasing activity in filtration and other chemical plant, and about 2,500 are employed in their two Colchester works. Rotary vacuum drum filters have been produced in ever-increasing numbers and more and more special forms are continually being devised to deal with many different substances. Apart from those already mentioned, they include sewage and effluent sludges, fruit pulp, neutralized acid sludge, penicillin, streptomycin, synthetic resins, yeast cream and vegetable protein. The appeal of vacuum filtration is therefore not limited to a few particular process industries, or sections within any one industry.

Paxman rotary vacuum filters vary in size between 1 sq. ft and 700 sq. ft peripheral area of the filter medium. The slurry is delivered into a trough of semicircular cross section, and the drum revolves within, partly submerged. The speed of rotation is generally between ¼ and 2 rpm dependent upon the material being filtered, drive being provided by means of a small electric motor and spur reduction gearing. The drum periphery is lined with perforated plates supporting the porous filter medium, which may be cloth, gauze or synthetic fibre. Internally it is divided into a number of pressure-tight cells from which channels communicate with ports in one or both of the end trunnions, dependent upon the size of the unit. Corresponding ports in the stationary valve head, communicating with the suction pump, are so arranged that the fluid is sucked into the drum through the submerged portion of the filter medium.

On the side of the drum leaving the trough, the vacuum continues to be applied for about half a revolution, thus drawing air through the filter medium in order to partially dry the cake adhering to the drum. The cake is finally remove by a scraper knife or other means such as a doctor roll or string discharge, see Fig. 2. Cake removal is usually assisted by blowing off for a short period at the end of the drying cycle. The cake may also be washed by providing water sprays around the top of the drum. Twin discharges from the valve head permit the slurry liquid and the washing liquid to be collected separately if desired.

The standard drum filter with scraper knife and no special attachments is basically simple and few changes have occurred. Formerly a paddle wheel agitator was fitted in the base of the trough to prevent settlement of the solids, but now an oscillating agitator suspended from the drum trunnions is used.

EXPANDING THE RANGE

Otherwise changes have generally been confined to expanding the range of additional refinements and design variations, and introducing special constructional materials, to suit widely differing substances for filtration. Stainless steel welded by the company's own method, cast iron or rigid pvc are optional filter materials as an alternative to fabricated mild steel.

For corrosive or abrasive slurries mild steel can be lined with rubber, ebonite, Monel metal or plastic, and a filter is currently being built to handle carborundum dust in suspension.

Interesting variations on the standard drum filter theme are the horizontal band, rotary disc and precoat types. The latter utilizes a precoating of diatomaceous earth as an additional filter medium where absolute purity of the filtrate is required, for instance in fruit juices or antibiotics. The scraper knife is coupled to a mechanism which advances it about one-thousandth of an inch for every rotation of the drum, thus continuously presenting the slurry with an unblemished surface. A replacement coating can be applied with about an hour's stoppage. The precoat filter is surely the ultimate in filter refinement.

The practical difficulties encountered with pressure filters are associated with the provision of totally enclosed casing and sealing arrangements designed to withstand a pressure of several atmospheres. The additional cost of a pressurized casing is not normally justified. Paxman are, however, experimenting with a pressurized unit with a view to rendering it a better commercial proposition. Totally enclosed vacuum filters can be supplied to handle toxic or particularly unpleasant materials.

One most important application of the vacuum rotary filter has been left until last—namely the dewatering of sewage and chemical effluent sludges. The company installed the first sewage sludge filtration plant at Dartford shortly before the war. Now with active measures under consideration for reducing the pollution of coastlines and rivers, local authorities are forced to consider the cost of mechanized filtration methods. The Paxman vacuum filtration system is becoming more popular in both Britain and abroad, its prime advantage over the conventional filter beds being its fractional comparative size and manpower requirement. The firm's latest step is to introduce a sludge concentrator in partnership with Equipment Development Company Incorporated of America. This device is a continuous sludge filter that does not work under vacuum.

The high standard of manufacture and the almost bewildering variety of forms in which the Davey, Paxman vacuum filter exists poses the vital question: how does the company make their filter business pay? Turning one's back on standardization in order to provide each customer with the optimum performance of his own peculiar requirement can so easily lead to the poorhouse.

The answer probably lies in the characteristics of the product. The rotary vacuum filter system by nature possesses such definite advantages over such machines as filter presses and centrifuges for many applications, that a sure potential demand exists. Finding such a scattered market is, however, not so simple. Today there are about a thousand Paxman vacuum filters in service up and down Britain, not to mention a lesser number at work overseas; but there must be many more places where older and less economical filtration methods are still in use.

Usually not more than two vacuum filters are included in one contract. Inquiries result both from advertising and from active representation by a small team of filtration engineers, some based at Colchester and some regionally. In order to study a prospective customer's problem, he is first asked to fill in a simple questionnaire, and then to send a sample of his slurry to Colchester for laboratory trials. If the substance happens to be one subject to rapid deterioration, such as penicillin, the company have portable pilot plants that can be fitted up for trials at the customer's own premises. Such tests help to provide both sides with valuable experience.

Mechanical troubles that sometimes occur are generally due to lack of maintenance, and service is an important aspect. Paxman's service department are on call 24 hours per day, and a new contract invariably includes erection supervision and starting up. Paxman's research and design engineers keep abreast of current filtration trends by attending conventions and holding open discussions with existing customers. Perhaps in the filtration game experience is the company's strongest asset of all.

Davey, Paxman Limited, Standard Ironworks, Colchester, Essex.

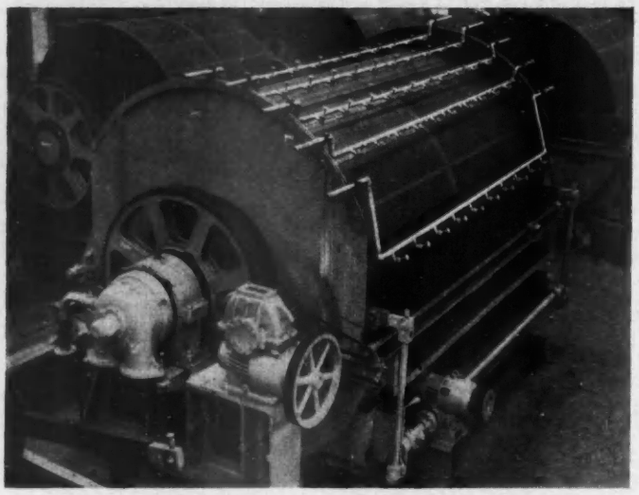


Fig. 5 (left) 250 sq. ft unit with wash gear in course of erection.

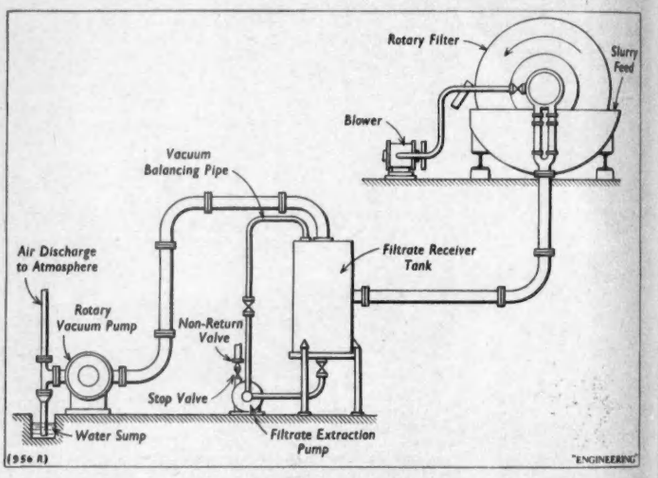


Fig. 6 (right) The filter's relation to the rest of the system.

Reduction of Fatigue Crack Propagation

Recent research investigations have been made to evaluate the effect of dodecyl alcohol on the rate of fatigue crack propagation in steel, stainless steel, aluminium and a copper beryllium alloy. Improvement factors ranging from 1·4 to 5·0 were found.

THE rate of fatigue crack propagation through a metal specimen has been found to be significantly reduced by the presence of an organic liquid such as dodecyl alcohol. This was confirmed after a recent series of studies made by the United States National Bureau of Standards.

The object of the research programme[1] was to investigate the role played by surface reactions in fatigue failure—a phenomenon which may occur in any material subjected to alternating stresses.

Fatigue failures are progressive and consist of two phases. The first, crack initiation, extends from the start of the stress application to the appearance of the first crack (which ultimately causes specimen failure); the second, a period of crack propagation, terminates with the abrupt fracture of the piece.

In a laboratory test, the duration of each phase depends on the type of specimen used. In earlier work at the Bureau of Standards,[2] using smooth cylindrical specimens, it was found that the presence of certain polar organic liquids on the surface of the specimens increased the fatigue strength of several metals. This improvement was primarily a measure of the effect of the liquids on fatigue crack initiation, since a large proportion of the total life of the specimens had been expended before cracks appeared. The reason for the improvement was thought to be that the polar compounds formed films on the metal which prevented deleterious reactions between the metal and the atmosphere.

Propagation Phase

To obtain information on the effect of such compounds on the crack propagation phase, fatigue tests were made with sharply notched cylindrical specimens in both a clean condition and with dodecyl alcohol on the surface. The notches serve as stress raisers; as a result, the effective stress at the root of the notch greatly exceeds the nominal stress applied to the specimen, and cracks appear at the notch at an early stage of fatigue life.

In the study, tests were conducted on specimens of 4340 steel, 17-7 PH stainless steel, 6061 aluminium alloy, and a copper-beryllium alloy (1·75 per cent beryllium). They were 0·365 in diameter, and notched around the middle to a reduced diameter of 0·250 in. To prevent variations in surface finish and in the amount of cold work produced in the surface of a specimen, the 0·005 in radius at the root of each notch was carefully ground. All of the tests were run on rotating-beam machines of the R. R. Moore type, operated at 3,000 rpm.

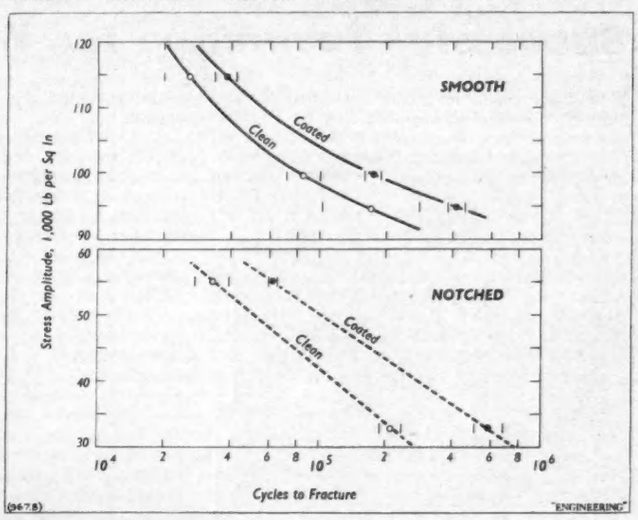
To determine the approximate point in the fatigue life when cracks first appeared, fatigue specimens of each metal were tested for small percentages of their expected fatigue life, and longitudinal sections of the specimens were examined metallographically for cracks. An analysis showed that the approximate portion of total fatigue life expended before cracks appeared was 5 per cent for the steel and aluminium; 10 per cent for the copper-beryllium alloy; and 35 per cent for the stainless steel.

Specimens to be tested in the coated condition were first stressed in the clean condition for the duration of their crack initiation period, and then for the remainder of the fatigue life, dodecyl alcohol was dripped into the notch. The results of these tests are given in the table. Data for all four alloys show that the duration of the crack-propagation period at two stress levels was increased by the dodecyl alcohol coating.

The results indicate that the coating, by limiting the access of molecules of oxygen or water to the metal surface, reduces the rate of detrimental surface reactions that normally occur when specimens are stressed in air. Two materials, the aluminium and stainless steel, showed a greater beneficial effect with notched specimens than they did with smooth specimens in the earlier study. This result may be associated with the relatively impermeable and adherent oxide films that form on these metals.

Material	Nominal Stress Amplitude	Thousands of Cycles of Stress						Ratio of Np Values Coated/Clean
		Clean			Coated with Dodecyl Alcohol			
	(1,000 lb per sq. in)	Nf	Nc	Np	Nf	Nc	Np	
4340 steel	32·5	210	10	200	586	10	576	2·9
	55	33	2	31	63	2	61	2·0
Cu-Be	30	749	78	671	3,406	78	3,328	5·0
	50	27	3	24	39	3	36	1·5
6061-T6 aluminium alloy	11·5	358	18	340	632	18	614	1·8
	17	81	4	77	120	4	116	1·5
17-7 PH stainless steel	42·5	115	40	75	325	40	285	3·8
	52·5	32	12	20	39	12	27	1·4

TABLE. *Tests to Determine the Effect of Dodecyl Alcohol on Fatigue Crack Propagation*
Nf = *Median fatigue life (5 to 7 specimens).* Nc = *Number of cycles required to produce a detectable crack.* Np = *Nf-Nc (crack propagation portion of fatigue life).*



(Right) Metal fatigue curves obtained on both smooth (above) and notched (below) specimens of 4340 steel. Specimens coated with dodecyl alcohol are seen to have increased fatigue life.

(Below) Dodecyl alcohol being applied to a notched test specimen mounted on a rotating-beam fatigue testing machine.

Prior to crack initiation, these films apparently minimize detrimental surface reactions. During the crack-propagation phase, however, each increment of crack extension provides an area of clean metal surface that may react with any oxygen in the atmosphere.

While these considerations provide a possible explanation for the effects of dodecyl alcohol coatings on crack initiation and propagation, the mechanism of the effect of surface reactions on fatigue is still not clear. Recent work, both at the Bureau and elsewhere, tends to show that the oxygen and the water vapour in the atmosphere are responsible for the reduction in fatigue life. Nevertheless, little explanation can be offered on the matter until more is known about the entire fatigue process.

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[1] Holshouser, W. L. and Utech, H.P. "Effect of Oleophobic Films on Fatigue Crack Propagation." *Transactions of ASTM*, Reprint No. 72, 1961.

[2] Frankel, H. E., Bennet, J.A. and Holshouser, W. L. "Effect of Oleophobic Films on Metal Fatigue." *J.Res.NBS*, p147, vol. 64 C, 1960.

Research Report

on work of the

US National Bureau of Standards, Washington 25, D.C.

Research Team

Dr. W. L. Holshouser
Dr. H. P. Utech

Research on Electricity Transmission

"Will nuclear power or thermonuclear power, or some new means of generating electricity, make local generation economic and render the transmission system redundant?"

This question was asked by Dr. J. S. Forrest, director of the Central Electricity Research Laboratories, when he recently delivered his inaugural address as chairman of the Supply Section of The Institution of Electrical Engineers. Dr. Forrest took as his theme "Research and Transmission."

He pointed out that the electricity supply load doubles every decade. The country's transmission voltage has had to be increased in steps of roughly 2 : 1 to handle the increased load. "We have now decided," said Dr. Forrest, "that the next step shall be 400 kV."

Dr. Forrest observed that, broadly speaking, the transmission voltage has been doubled every 20 years. He quoted figures to indicate that the choice of voltage through the years has not been far wrong and forecast that we should require 550 kV in about 1980.

This was the picture which he drew to illustrate the background for current research in transmission and he went on to discuss some of the more interesting problems of what he called the most important part of a transmission system—the overhead line.

Dr. Forrest referred to the corona discharge which occurs as the result of the increase in line voltage, leading to loss of power and the generation of radio noise which can interfere with radio and television reception. Fortunately, there is an elegant solution to this problem in the use of a "bundle" of two, three or four conductors. This was first suggested in 1932 and it is interesting that many transmission engineers were slow to accept "bundle" conductors; it was not until about 1950 that they were generally recognized as being the best system for voltages of 300 kV and above.

Considerable research has been carried out on the phenomenon of the oscillation of overhead-line conductors, movements which Dr. Forrest described as "dancing" and "galloping." Until recently this type of oscillation was thought to be associated with the formation of ice on the conductor; this alters the aerodynamic shape of the conductor so that a steady horizontal wind could lift it and set it into oscillation. Recently, however, there has been evidence of this happening when no ice has been present and, in particular, this phenomenon has caused the clashing of conductors on the new 275 kV crossing of the River Severn between Aust and Beachley, which has a span of 5,310 ft and 1·7 in diameter conductors. Research has indicated that this aerodynamic lift can be reduced by using a conductor with a smooth cylindrical outer surface, but it is not yet known whether this will be a complete cure.

After referring to other problems associated with overhead-line conductors and the design of tower foundations, Dr. Forrest went on to talk about insulators.

"The original 132 kV Grid system," Dr. Forrest said, "is a testimony to the experience and the foresight of the CEB engineers and consultants who planned it." Appreciating that insulation was a difficult problem in this country, they provided a degree of insulation which was generous by standards in other countries. However, as they had no service experience in this country above 66 kV and no research data to guide them, the initial insulation proved inadequate in industrial districts. This created a serious position and, in view of the industrial situation at that time, had political repercussions. Research work was started, initially at Glasgow in 1930, which concentrated on the performance of insulators in polluted atmospheres, and resulted in substantially improved insulation.

After describing types of insulator used in various countries, Dr. Forrest concluded by examining future possibilities. A new discovery made at the Bell Telephone Laboratories, USA, brings the practical application of superconducting materials much closer. This is a new material, a niobium-tin alloy which retains its superconductivity in fields of up to 100,000 Gauss. "The fundamental physical barrier," Dr. Forrest claimed, "has been removed and only a technological problem (that of cooling) remains to be solved before superconducting transformers and cables are developed."

Successful Technique for Welding Titanium

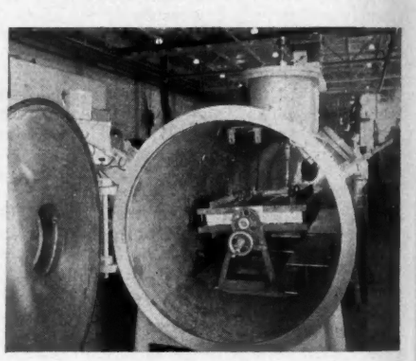
It may be possible to make nuclear submarine hulls of titanium alloys, according to a report which describes a new welding process developed at the Battelle Memorial Institute, Ohio, USA. Hulls made of titanium alloys—which are strong as many steels and weigh only about two-thirds as much—would provide submarines with greater speed, payload and diving depth.

In a technical paper recently presented at the annual meeting of the American Welding Society in Dallas, Texas, Battelle welding engineers reported that they have produced crack-free welds in 120,000 lb per sq. in-yield, 2 in-thick titanium alloy plates. Weld joint properties equalled or exceeded the properties f the base alloy.

The thick-plate welding study made at the Columbus Research Centre has been part of a comprehensive programme sponsored by the Bureau of Naval Weapons to evaluate titanium alloys for submarine use. Previously $\frac{3}{4}$ in titanium plates were the thickest that could be welded.

At Battelle, welds were made in plates with a double-vee joint design using an automatically controlled consumable-electrode process. To prevent contamination which might cause weld cracking, all welding was done in an argon filled chamber. Welding conditions of 365 amps, 32 arc volts, and a 15 in per minute travel speed were used to produce heat inputs of about 45,000 joules per in.

The best combination of yield strength and impact properties was obtained with commercially available Ti-6Al-4V alloy plates and an experimental 5A1-2Cb-1Ta alloy filler wire. However, according to the paper, which was read by Mess·s. W. J. Lewis, G. E. Faulkner and P. J. Rieppel, plates with even better strength and impact properties might be produced by making slight changes in the composition of the plate and filler alloys.



2 in thick titanium plates are welded in this chamber using an argon atmosphere to prevent weld cracking.

Promising Device for Thermionic Conversion

A gas discharge device of a new type, in which heat is converted directly into electrical energy, is being investigated under the supervision of Professor D. Gabor at City and Guilds College, London. A brief report is given in the College's Research Report for the period 1958 to 1961, which has just been published.

In the new device, electrons are emitted by a hot cathode. The energy imparted to these electrons may originate from a flame or a nuclear heat source. Electrons move from the cathode with energies corresponding to the work function of the cathode material (say 3 volts), to a collector electrode with a smaller work function (say 1·5 volts). If there were no voltage drop in the gas space, the voltage difference (say 1·5 volts) could be utilized in the load. In such discharges, however, the voltage drop in the gas space is considerable.

In the new form of discharge, the voltage drop in the gas space is kept small by neutralizing the space charge with positive ions, which are provided in a novel way. They are produced by an auxiliary discharge in a space separated from the main discharge by a metal gauze. With suitable dimensioning, the power required for the auxiliary discharge may be made very small. It has been shown experimentally that the space charge of a current of one ampere can be provided by 0·1, or even 0·05, watts, and efficiencies of 25 to 30 per cent can be expected for such combinations.

Much further research is said to be required to bring this possibility into engineering application, including the development of suitable cathode materials and structures to give economical life at the high temperatures required for high efficiency, and the development of insulating materials that will permit the maintenance of the required vacuum under these conditions.

Besides the radical advance in the potential efficiency of conversion, this type of discharge opens up a second possibility that may greatly increase its value in application: it can be made to supply its output in the form of alternating current. For this purpose, two (or more) anodes are provided, and by control of the auxiliary discharges the main discharge is direct via these anodes alternately or in sequence. The power may then be transformed to a higher voltage.

This may overcome one of the chief disadvantages of thermoelectric converters, since large direct currents at low voltages have a very limited range of direct applications. This production of alternating current is, however, only achieved at some expense to the efficiency, because there are radiation and conduction losses from the two anodes, each of which is only working half the time.

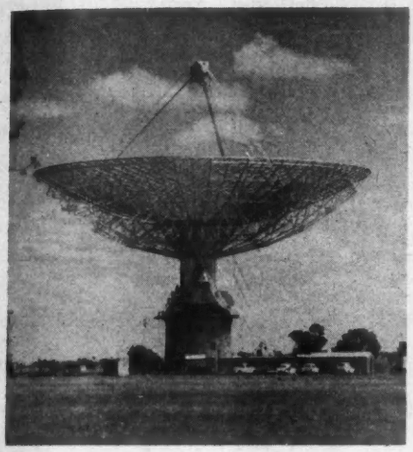
This potentially important development programme is being conducted in conjunction with the National Research Development Corporation.

Radio Telescope Near Completion

The new radio telescope of the Commonwealth Scientific and Industrial Research Organisation is now nearing completion at Parkes, New South Wales, 240 miles west of Sydney.

The illustration below shows the dish in the parked position, which will be necessary when winds are over 25 miles per hour. The diameter of the dish is 210 ft and, although this is 40 ft less than the Jodrell Bank telescope, the Australian instrument is expected to have a better performance in some respects. This is because the "hydrogen line" had not been discovered at the time the Jodrell Bank telescope was being designed so that it cannot, unlike the Australian one, be used at full aperture down to a wave length of 21 cm. The CSIRO dish is designed to have a surface accuracy of plus or minus half an inch under all temperature conditions and with winds of up to 10 miles per hour. It can also be steered to an accuracy of one minute of arc.

The tower is 39 ft in diameter, 42 ft high and



A new radio telescope, with a dish diameter of 210 ft, will soon be operating in Australia.

the total weight of the foundation is 1,750 tons. The actual reflective surface is made of 13,000 small mesh panels on the face of the dish.

The cost of the telescope is estimated at £A611,500, of which the Australian Government has provided half. The remainder has come from the Carnegie Corporation, the Rockefeller Foundation of New York and (£A27,000) from private Australian subscriptions.

The designers of the telescope are Fox and Partners of London, the builders were a West German firm, who completed their task in under two years. The servo-control system was supplied under sub-contract by Metropolitan Vickers, Manchester.

Australian Research on Cutting Tools

A comprehensive series of statistically designed tests, covering ranges of cutting speeds, feeds and depths, have been carried out on six makes of ceramic tools by the Metrology Division of the National Standards Laboratory, Sydney, Australia.

Evaluation of the results indicates that the depth of cut has little significant effect upon tool wear, and that the cutting speed exponent varies between 1·2 and 2·7, approximately. The low exponent values suggest that abrasion is the main cause of tool wear for ceramic tools. The tests also indicate that, contrary to many published reports, certain ceramic tools can withstand quite severe vibrations. A paper giving the salient points of this investigation is now being prepared for publication.

The suitability of the facing test as a means of assessing the performance of tungsten carbide cutting tools is being explored. If successful, the test could be used to control the quality of production in the toolmaker's works in much the same way as it is being used in the steelmaker's works to control the quality of the heats of free-cutting steel.

Following upon work done in deriving the temperature distribution within the shear region ahead of the cutting edge, an attempt has been made to relate the geometry of the plastic strip-line field with the geometry of the metal particle trajectories. By assuming that the metal deforms by a flow process, it has been found possible to calculate the angular width of the region from measured values of the chip thickness, cutting velocity and chip grain orientation.

The method has been found to give results which are in accord with the equations published by other authors. The nature of the metal flow past a blunt cutting edge is still being investigated. Experimental techniques are being developed, and include the use of ruled gratings, analogue models and quick stop devices. Attention is also being paid to the mathematical calculation of slip-line fields.

Scientific Control of River Pollution

Pollution caused by material discharged into the Thames estuary is being substantially reduced at present and will be still further reduced by improvements to a number of sewage works which discharge into the estuary. Taken together, the improvements ought by the end of 1962 to be enough to prevent offensive conditions in the tidal Thames, except possibly in the most unusual droughts.

This is one of the conclusions contained in the report of a committee on pollution of the tidal Thames, presented to the Minister of Housing and Local Government, and published on 20 October. The committee under the chairmanship of Professor A. J. S. Pippard, has collaborated for 10 years with the Water Pollution Research Board of the Department of Scientific and Industrial Research in an investigation of the effects of heated effluents and other discharges into the tidal reaches of the Thames. A great deal of scientific information has been obtained which will be published by DSIR.

The forecast is made possible by a new method of assessing the effect of any given effluent on the condition of the river, which is being developed by the Water Pollution Research Laboratory. The report says: "... the fact that such predictions can now, for the first time, be made, even with some reservations as to their accuracy, appears to us to point the way to the scientific control of pollution in the Thames estuary and in other estuaries sharing the same characteristics".

At the time they were appointed, the committee found the estuary to be in a badly polluted and frequently offensive state. Reviewing how far improvement is reasonably practicable, they have concluded that it would be difficult to achieve more than an insurance against nuisance without "extraordinary measures at very heavy cost," which they think would be out of proportion to any likely gain. For example, to enable salmon to pass through the estuary it might be necessary, among other things, to treat sewage at some disposal works to a standard never yet reliably achieved anywhere. The committee therefore accept as the objective the prevention of offensive conditions together with a margin of safety. They have concluded that current improvements to sewage works when completed should be enough to prevent objectionable smells in the river, but probably not enough to provide a reasonable safety factor. But, the report says, it would be premature to make recommendations for additional works which might cost millions of pounds before the predicted effect of these improvements has been checked by experience.

Four sewage works were responsible for about nine-tenths of the sewage effluent discharged directly into the tidal Thames. Important improvements have been made at these and other works at considerable cost. These improvement schemes, either completed or in progress, include one of £10m, another of £8m, and others running into hundreds of thousands of pounds each.

Storm water discharges contributed an average of 1½ per cent of the total pollution load entering the estuary. Direct industrial discharges accounted for about 9 per cent of the polluting material in 1952/3, but the load attributable to these is now at about one-third of its 1953 level.

Sulphite discharged from the Battersea and Bankside power stations causes an appreciable loss of oxygen near the station outlets, but has no material effect on the rest of the estuary.

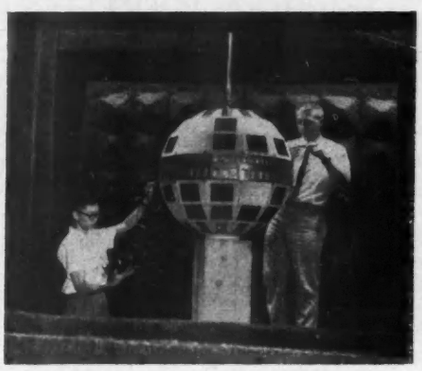
The introduction of synthetic detergents in and after 1949 was followed by a marked lengthening of the zone devoid of oxygen. The adoption of a new type of detergent which is being used experimentally may have beneficial results.

Additional heat discharges to the worst polluted reaches of the estuary should be avoided, say the committee, but discharges of heat at their present level would not seriously affect pollution if there were always some oxygen available in the water.

The committee recommend that new polluting discharges above Lower Hope Reach (below East Tilbury) should be avoided if at all possible, and even below this point proposals for new discharges should be carefully considered. All important effluents should, in future, receive individual consideration instead of having to conform to a general standard applied to all effluents in a particular stretch of the river.

Preparations for Communication Satellite

The illustration below shows a development model of a communication satellite being prepared for transmission experiments by engineers



Placed in a test chamber which simulates the radio conditions of space, the model satellite is being tested for its aerial characteristics.

of the Bell Telephone Laboratories, Holmdel, New Jersey, USA.

The specially constructed test chamber, simulating the radio environment of space, is near the Bell Laboratories' location where communications experiments with the historical Echo satellite were conducted last year in cooperation with the National Aeronautics and Space Administration.

The satellite, intended for experiments in relaying telephone, television and other long-distance communications, is scheduled for launching next spring.

The 34 in sphere has 72 gem-like facets. Rectangular patches seen on some of the facets are arrays of solar cells, covered with strips of man-made sapphire for protection against radiation. The solar cells, invented at the Bell Laboratories, convert sunlight into electricity. Microwave receiving and transmitting aerials are in the mid-section.

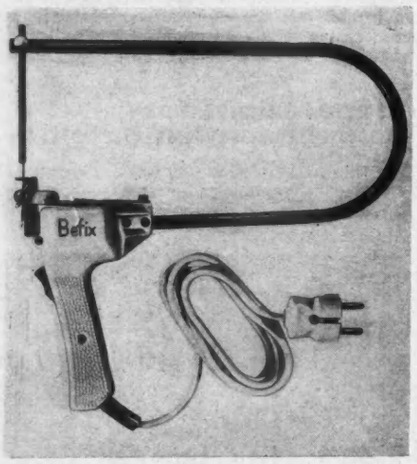
Three Hand Tools

FROM Germany comes news of three tools for the handyman; one power operated, another offering a combination of eight possibilities and the third a powerful clamp.

The first is the BeFix I electrically driven fretsaw available from Margenburg, Frankfurt-am-Main, West Germany. Particular claims are for speed and accuracy of cutting. The standard model is suitable for wood up to 15 mm thick ($\frac{5}{8}$ in) and for non-ferrous metals up to 2 mm thick ($\frac{1}{8}$ in). It will cut most plastics, veneers and such other items as cork and balsa wood, the last up to 25 mm thick (1 in).

The handle, which contains the power unit, is made of polystyrol material, resistant to impact; it is completely insulated. Any commercial make of saw blade can be used, being held in the oscillating armature by a setscrew on one side. There is a tubular guide to steady the blade. A broken blade can still be used as long as there is 4 cm (1½ in) of it left. To enable large sections which are too deep for the U frame to be cut, the blade can be clamped at an angle or even turned through a full right-angle by means of pliers. For cutting holes, the blade can be inserted through the drilled starting hole by lifting the guide tube clear, and the business of dismantling the saw is thus avoided.

To steady the saw on the work and at the same time to keep the blade perpendicular to it, there is a small supporting table mounted on the handle. The saw can be used in the hand or, for long or repetition work, it can be held in a vice or clamp on the bench.



High cutting speeds are possible with the BeFix electric fretsaw.

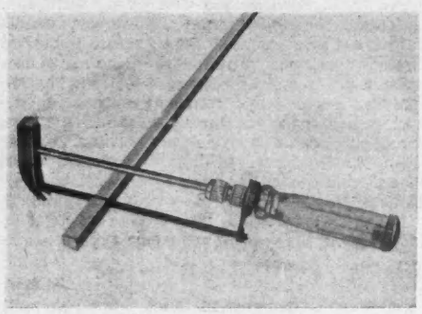
After selecting the blade appropriate to the material to be cut, it is inserted into a groove between two steel discs and clamped by the wing nut. The guide tube is next slid over the blade and fixed, leaving enough of the blade open to suit the thickness of the material. Only a light forward pressure is needed—too heavy a pressure can slow down the speed and produce bad work.

The standard model is rated for 220-240 V ac with a consumption of only 40 to 45 watts. Control is by a microswitch on the handle. As there are no moving parts except the armature, the tool is not subject to wear. The U frame is made of steel tube finished in black and the handle is available in a choice of colours, red, emerald green or white.

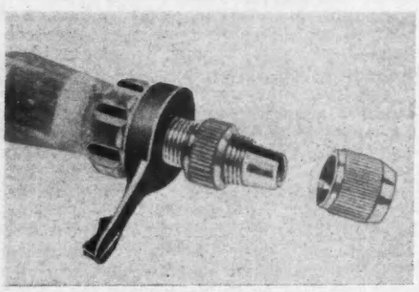
The combination tool is the Bastlerfreund made by A. Macco, Mendlessohnstrasse 50, Stuttgart-Sillenbuch. It consists basically of a plastics handle with a multi-purpose chuck. In the chuck can be fitted various points including a hammer, two sizes of screwdriver, a socket screwdriver and an awl.

With the possible exception of the hammer, all these tools can be considered as "standard" items in a combination set, but the remaining choice is the special feature. By fitting a holder on the chuck base, it is possible to fit a standard small hacksaw blade between it and the forks of the hammer, thus greatly extending the uses of the Bastlerfreund. All the interchangeable points apart from the hammer can be stored in the hollow handle.

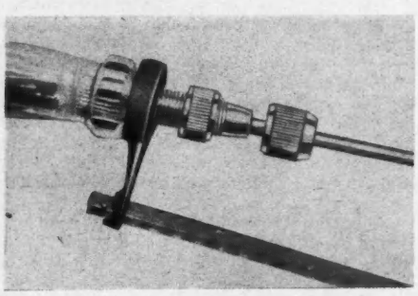
Last of the group is the Bessey all-steel lever clamp working on the cam principle. The manufacturers are Bessey und Sohn, Prazisions-Ziewerk, Bietigheim, Wurtemberg. It consists of a steel bar with one end bent round at a right-angle to carry one of the clamp pads. Sliding on the bar is an arm carrying the second pad and also the clamping lever. By having the bar in rail form a considerable saving in weight is claimed.



The Bastlerfreund is a tool with eight combinations; here it is being used as a saw.



The screwdriver fitments are held in a chuck.



The saw is gripped between the hammer head and an arm that fits on the chuck stem, held in place by a locking ring.

On the clamping lever is a pawl that engages with a ratchet on the arm to lock the pads in the tightened position. The ratchet is forged out of the arm itself so that it possesses considerable strength and allows high clamping pressures to be exerted. Tightening up is effected by closing in the handle to the main bar. A particular claim is the speed of operation as compared to aclmps tightened with wing nuts or screws.

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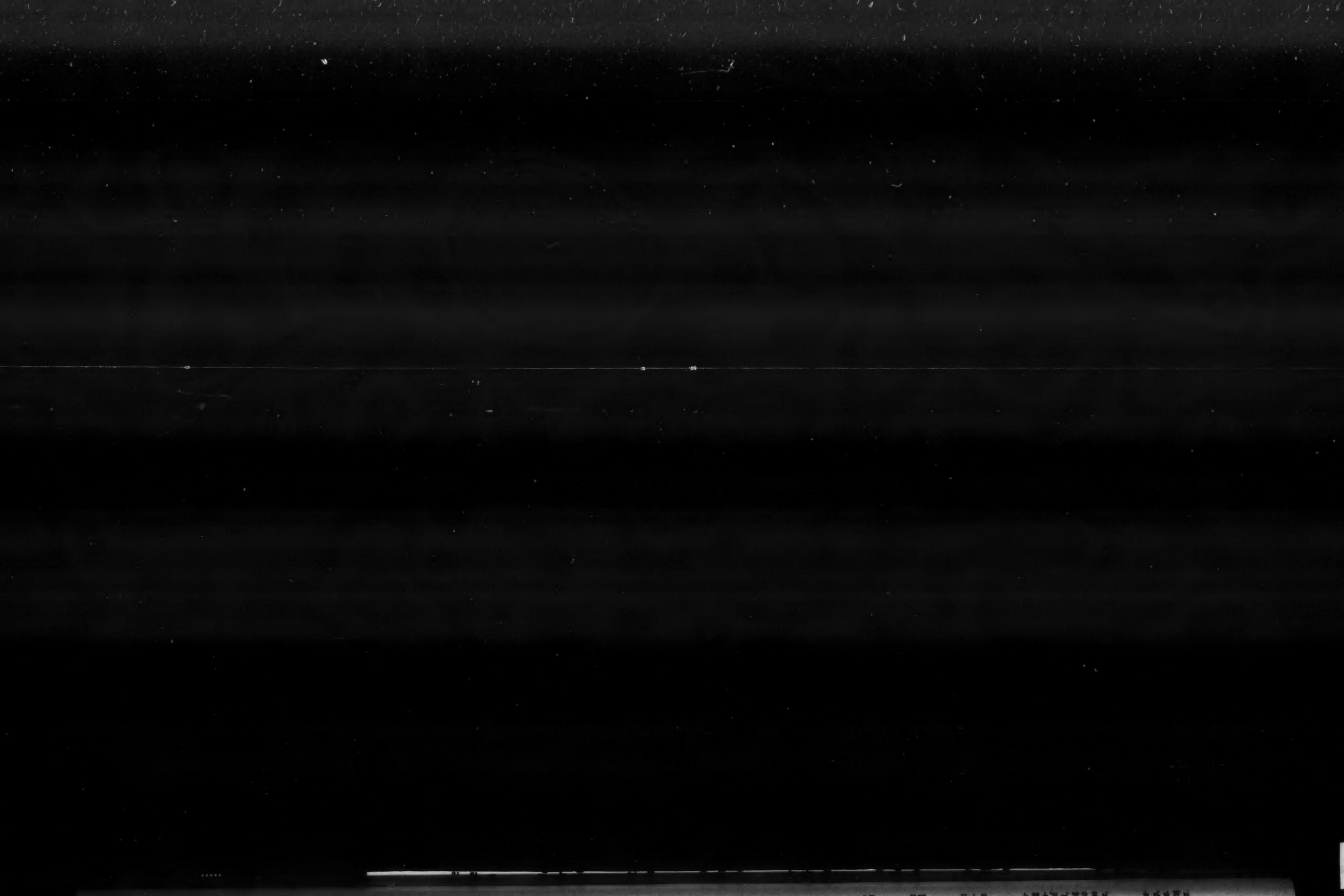
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